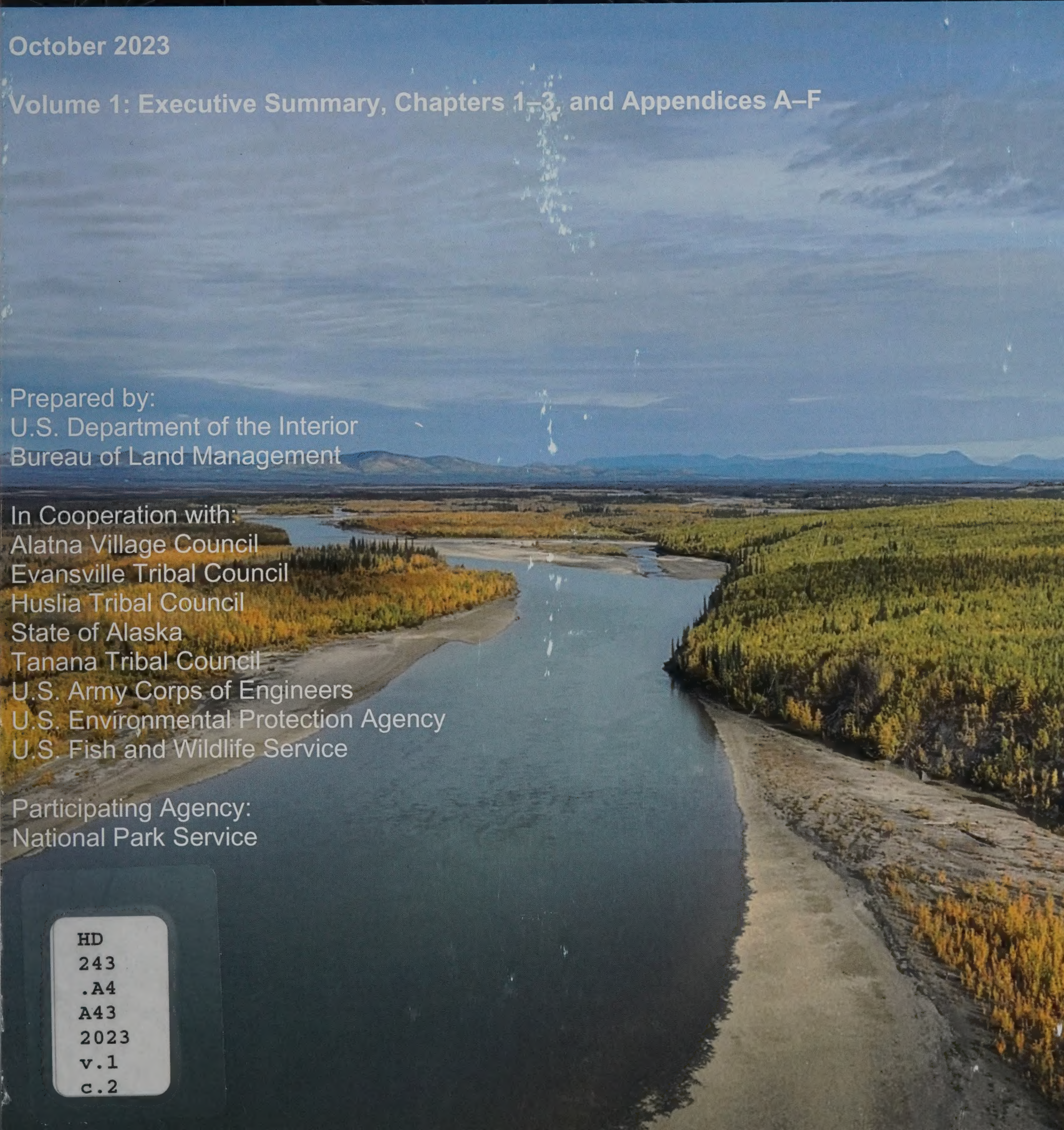
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND
MANAGEMENT

Ambler Road

Draft Supplemental Environmental Impact Statement

October 2023

Volume 1: Executive Summary, Chapters 1–3, and Appendices A–F



Prepared by:
U.S. Department of the Interior
Bureau of Land Management

In Cooperation with:
Alatna Village Council
Evansville Tribal Council
Huslia Tribal Council
State of Alaska
Tanana Tribal Council
U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

Participating Agency:
National Park Service

Mission

To sustain the health, diversity, and productivity of public lands for the use and enjoyment of present and future generations.

Cover photograph: Middle Fork of the Koyukuk River in fall foliage.

Photograph courtesy of BLM staff

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DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT — AMBLER ROAD

Lead Agency:	U.S. Department of the Interior (DOI), Bureau of Land Management (BLM)
Participating Agency:	DOI, National Park Service (NPS)
Cooperating Agencies:	Alatna Village Council, Evansville Tribal Council, Huslia Tribal Council, State of Alaska, Tanana Tribal Council, U.S. Army Corps of Engineers (USACE), U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service
Proposed Action:	AIDEA requests permission to construct, operate, maintain, and reclaim an all-season industrial access road to the Ambler Mining District in support of mining exploration and development.

Abstract:

The Bureau of Land Management (BLM) has prepared the Ambler Road Draft Supplemental Environmental Impact Statement (EIS) to consider the environmental effects of issuing federal authorizations in response to the right-of-way application from the Alaska Industrial Development and Export Authority, a public corporation of the State of Alaska.

In response to a May 2022 court remand, the proposed Ambler Road, which was analyzed in the March 2020 Final EIS and authorized in a joint record of decision issued in July 2020, is being further evaluated. The U.S. District Court for Alaska (District Court) remanded the challenged decisions to BLM due to deficiencies in, amongst other things, the BLM's analysis of subsistence impacts under the Alaska National Interest Lands Conservation Act and tribal consultation pursuant the National Historic Preservation Act. In its remand motion, the DOI also stated its intention to further supplement the EIS analysis to more thoroughly assess the impacts and resources identified as areas of concern.

This Draft Supplemental EIS analyzes the No Action Alternative; Alternative A, the applicant's 211 mile-long proposed alignment beginning at Mile 161 of the Dalton Highway and extending west, ending at the Ambler River; Alternative B, which starts and ends in the same location as Alternative A but contains a shorter route through Gates of the Arctic National Park and Preserve; and Alternative C, an alternate route that starts at Mile 59.5 of the Dalton Highway and extends 332 miles northwest, also ending at the Ambler River.

This Draft Supplemental EIS substantially revises the analysis of the following resources in detail: Water Resources, Air Quality and Climate, Vegetation and Wetlands, Fish and Aquatics, Birds, Mammals, Transportation and Access, Environmental Justice, Subsistence, and Cultural Resources.

Review Period:	The review period for the Ambler Road Draft Supplemental EIS is 60 calendar days. The review period began when the Environmental Protection Agency published a notice of availability in the *Federal Register* on October 20, 2023. The review period ends on December 19, 2023.
Further Information:	Contact Stacie McIntosh, BLM Project Manager at (907) 474-2398 or visit the Ambler Road EIS website at: www.blm.gov/AmblerRoadEIS.

Dear Reader:

This Ambler Road Draft Supplemental Environmental Impact Statement (EIS) further analyzes the action considered in the Ambler Road Final Environmental Impact Statement, which was published in March 2020 and authorized in a joint record of decision (JROD) issued by the Bureau of Land Management (BLM) and the U.S. Army Corps of Engineers (USACE) in July 2020. This action is being taken as authorized by the May 2022 order of the U.S. District Court for Alaska (District Court), which granted a voluntary remand of the JROD so that the BLM could address deficiencies in the analysis of subsistence impacts under the Alaska National Interest Lands Conservation Act and Tribal consultation pursuant the National Historic Preservation Act and supplement the EIS to more thoroughly assess impacts and resources identified as areas of concern. I am pleased to present the Ambler Road Draft Supplemental EIS for your review.

The Ambler Road Project is a proposal of the Alaska Industrial Development and Export Authority (AIDEA), a State of Alaska public corporation. AIDEA has proposed constructing a new 211-mile long industrial access road from the Dalton Highway to the Ambler Mining District in Northcentral Alaska to facilitate mining exploration and development. As proposed, the route would pass near Native Alaskan communities and through largely undeveloped land. AIDEA's proposed route begins and ends on public lands managed by the BLM, which required AIDEA to apply for and obtain a right-of-way authorization, which was issued to AIDEA in January 2021 and suspended upon approval of the voluntary remand by the District Court. The decision to be made from this Supplemental EIS process is whether the BLM will reissue, amend, or deny, in whole or in part, authorization of the project, based on the analysis contained in this Supplemental EIS as well as other federal review processes.

The BLM encourages the public to review and provide comments on the Draft Supplemental EIS. This document is intended to fully disclose known or anticipated effects and to offer the public and government agencies the opportunity to comment on draft conclusions. The BLM is especially interested in any new information that would help the agency produce the Final Supplemental EIS, which will aid the decision maker in selecting an alternative and providing stipulations or mitigation measures related to the proposal.

Comments will be accepted for 60 calendar days following publication of the U.S. Environmental Protection Agency's Notice of Availability in the *Federal Register*. The BLM will evaluate all comments received and address substantive comments in the Final Supplemental EIS scheduled to be released in 2024. Your review and comments are critical to the success of BLM decision-making. We request that you make your comments as specific as possible. Comments are most helpful if they include suggested changes, data sources, or analysis methods and refer to a section or page number. Comments containing only opinion or preference will be considered as part of the decision-making process but will not receive a formal response from the BLM.

The Draft Supplemental EIS is available for review online on the project website at: www.blm.gov/AmblerRoadEIS. Paper copies are also available for public review at the following locations:

BLM Alaska State Office Public Information Center (Public Room)
222 West 7th Avenue
Anchorage, Alaska 99513

BLM Fairbanks District Office Public Room
222 University Avenue
Fairbanks, Alaska 99709

Comments may be submitted electronically, by mail, or in person.

Electronically: www.blm.gov/AmblerRoadEIS

Mail (or hand deliver): Ambler Road Supplemental EIS Comments
BLM Fairbanks District Office
222 University Ave., Fairbanks, Alaska 99709

Before including your address, phone number, email address, or other personal identifying information in your comment, be advised that your entire comment, including your identifying information, may be made publicly available at any time. While you may ask us in your comments to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Public meetings and hearings will be held at various locations in the project area and in Fairbanks and Anchorage, with opportunities to submit comments and seek additional information. The locations, dates, and times of these meetings will be announced prior to the first meeting via a press release and on the project website.

Thank you for your interest in the Ambler Road Draft Supplemental EIS. We appreciate the information and suggestions you contribute to this EIS process.

Sincerely,

Steven M. Cohn
State Director, Alaska

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Acronyms and Abbreviations

°F	degrees Fahrenheit
AAAQS	State of Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
AADT	Annual Average Daily Traffic
ABR	ABR Inc. – Environmental Research & Services
ACCS	Alaska Center for Conservation Science
ACEC	Areas of Critical Environmental Concern
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADHSS	Alaska Department of Health and Social Services
ADNR	Alaska Department of Natural Resources
ADOLWD	Alaska Department of Labor and Workforce Development
AFS	Alaska Fire Service
AHRS	Alaska Heritage Resources Survey
AICC	Alaska Interagency Coordination Center
AIDEA	Alaska Industrial Development and Export Authority
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
APE	Area of Potential Effects
AQCR	Air Quality Control Region
ARD	acid rock drainage
ARDF	Alaska Resource Data File
AS	Alaska Statute
ATV	all-terrain vehicle
$\mu g/m^3$	micrograms per cubic meter
AWC	Anadromous Waters Catalog
BLM	Bureau of Land Management
BMP	best management practice
BP	Before Present
CAA	Clean Air Act

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COPD	chronic obstructive pulmonary disease
CWA	Clean Water Act
dBA	A-weighted decibels
DENA	Denali National Park and Preserve
DGGS	Alaska Division of Geological and Geophysical Surveys
District	Ambler Mining District
DMTS	Delong Mountain Transportation System
DOI	U.S. Department of the Interior
DOT&PF	Alaska Department of Transportation and Public Facilities
EEA	Environmental and Economic Analysis
EFH	essential fish habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
f/cc	fiber per cubic centimeter
FHWA	Federal Highway Administration
FMP	Fishery Management Plan
FNSB	Fairbanks North Star Borough
G2G	government-to-government
GAAR	Gates of the Arctic National Park and Preserve
GHG	greenhouse gas
GIS	Geographic Information System
GMU	Game Management Unit
GPS	Global Positioning System

HAP	hazardous air pollutant
HB	House Bill
HDR	HDR Alaska, Inc.
HHH	Hodzana Hills Herd
HUC	hydrologic unit code
IMPLAN	Impact Analysis for Planning
ISPMP	Invasive Species Prevention and Management Plan
JTC	Yukon River Joint Technical Committee
Kobuk	Kobuk Ridges and Valleys
LEDPA	least environmentally damaging practicable alternative
MAAT	Mean Annual Air Temperature
MP	Milepost
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NAB	Northwest Arctic Borough
NANA	NANA Regional Corporation, Inc.
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNIS	non-native invasive species
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOA	naturally occurring asbestos
NOAA	National Oceanic and Atmospheric Administration
NPR-A	National Petroleum Reserve in Alaska
NPS	National Park Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
O_3	ozone
OHV	off-highway vehicle

OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAH	polycyclic aromatic hydrocarbon
PCE	Power Cost Equalization
PEM	palustrine emergent
PFO	palustrine forest
PFYC	Potential Fossil Yield Classification
PGE	platinum group element
PM_{10}	particulate matter less than 10 microns
$PM_{2.5}$	particulate matter less than 2.5 microns
PML	palustrine moss/lichen
ppm	parts per million
PSS	palustrine scrub-shrub
REA	Rapid Ecoregional Assessment
REE	rare earth element
RFAs	reasonably foreseeable actions
RHA	River and Harbors Act
RMH	Ray Mountains Herd
RMP	Resource Management Plan
RNA	Research Natural Area
ROD	Record of Decision
ROW	right-of-way
RS2477	Revised Statute 2477
SF299	Standard Form 299
SO_2	sulfur dioxide
SRMA	Special Recreation Management Area
State	State of Alaska
SWPPP	Stormwater Pollution Prevention Plan
TAPS	Trans-Alaska Pipeline System
TCEs	Terrestrial Coarse-filter Conservation Elements
TCP	Traditional Cultural Property

TES	threatened and endangered species
tpy	tons per year
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VHF	very high frequency
VOC	volatile organic compounds
vpd	vehicles per day
VRI	Visual Resource Inventory
VRM	Visual Resources Management
WAH	Western Arctic Herd
WAH WG	Western Arctic Caribou Herd Working Group
WOTUS	Waters of the U.S.
WSR	National Wild and Scenic River System
YKCA	Yukon-Koyukuk Census Area

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Executive Summary

Introduction

The U.S. Bureau of Land Management (BLM) in Alaska prepared an Environmental Impact Statement (EIS) as required by the National Environmental Policy Act (NEPA) to analyze the Alaska Industrial Development and Export Authority's (AIDEA's) application for a right-of-way (ROW) authorization across federal public land to allow for an industrial access road from the Dalton Highway to the Ambler Mining District (District) in Northcentral Alaska. A Final Ambler Road EIS was released in March 2020 and a Joint Record of Decision (JROD) was issued in July 2020. Litigation commenced in August and October 2020. In February 2022, the U.S. Department of the Interior (DOI) moved the U.S. District Court for Alaska (District Court) to grant voluntary remand, stating that additional legal analysis revealed deficiencies in, amongst other things, the BLM's analysis of subsistence impacts under Alaska National Interest Lands Conservation Act (ANILCA) Section 810 and consultation with Tribes pursuant to Section 106 of the National Historic Preservation Act (NHPA). In addition, the DOI stated it intended to supplement the National Environmental Policy Act (NEPA) analysis on remand. In the motion for remand, the Department of the Interior (DOI) committed to consider new information about declines in salmon and caribou populations; reconsider the appropriate scope of the area of potential effects for purposes of the NHPA; revisit whether Tribes should be included as invited signatories to the PA; and supplement the EIS, as appropriate, to more thoroughly assess the impacts and resources identified as areas of concern in the two lawsuits challenging the JROD. On May 17, 2022, the District Court ordered remand of the July 2020 JROD. This Draft Supplemental EIS has been developed by the BLM to analyze the proposed AIDEA action in accord with its obligations under, amongst other things, NEPA, ANILCA, and the NHPA.

The Alaska State Office of the BLM has prepared this Draft Supplemental EIS as required by NEPA. A Supplemental EIS is prepared when there are significant new circumstances or information relevant to environmental concerns that have bearing on the proposed action or its effects. The BLM was the lead federal agency for the initial EIS and is responsible for preparation of the Supplemental EIS. AIDEA's ROW application proposes construction of a road, including multiple material sites, temporary construction camps and long-term maintenance camps, airstrips, a fiber-optic communications line, radio communications sites, and guard stations. In its application AIDEA requested a 50-year term of the ROW authorization and stated that it would close and reclaim the road thereafter (i.e., camps, communications, bridges, and culverts removed). The proposed BLM federal action is approval of the ROW application.

ANILCA exempted from NEPA the decision of where that route should go across the National Preserve portion of Gates of the Arctic National Park and Preserve (GAAR). Congress did not make a similar exemption for BLM-managed lands or for other federal permits that would be required. The purpose of this Supplemental EIS, therefore, is to disclose to the public and federal decision-makers impacts of the proposal in accordance with NEPA.

The Supplemental EIS will also serve as the basis for decisions that other federal agencies must make, such as issuance of a permit for fill in wetlands and waters of the United States by the U.S. Army Corps of Engineers (USACE). The USACE, U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency, and the State of Alaska served as cooperating agencies. The National Park Service (NPS) is a participating agency. Alatna Village Council, Evansville Tribal Council, Huslia Tribal Council, and Tanana Tribal Council are cooperating agencies for their special expertise related to traditional knowledge and for input on subsistence and cultural resources.

Ultimately, the BLM will make a decision to select one of the alternatives evaluated, including the No Action Alternative. The decision will be documented in a Record of Decision (ROD) that identifies the final decision and the mitigation and stipulations required of AIDEA if the project is approved.

Purpose and Need

The BLM is responding to an application for a ROW under Title V of the Federal Land Policy and Management Act (FLPMA) for year-round industrial surface transportation access across BLM-managed lands to the Ambler Mining District.

The USACE is a cooperating agency for this project and also has its own purpose and need to consider. Under Section 404(b)(1) guidelines, the USACE has a *basic purpose* to determine whether the proposed project is water dependent. Then, the USACE has an *overall purpose* that, based on AIDEA's purpose and need, serves as the basis for identifying practicable alternatives to the applicant's proposed project. In its review as a cooperating agency, the USACE indicated that its *overall purpose* is "to provide year-round surface transportation access for mining exploration and development in the Ambler Mining District."

Decision to be Made

The BLM and other authorizing cooperating agencies will decide whether to reissue, amend, or deny, in whole or in part, authorizations for the project, based on the analysis contained in the Final Supplemental EIS, as well as other state and federal review processes.

The portion of the proposed road across GAAR is authorized in ANILCA Section 201(4)(b), which stipulates that the Secretary of the Interior "shall permit" "access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve" for access to the District. ANILCA also directed that the portion of the road crossing NPS lands be analyzed in an Environmental and Economic Analysis (EEA) in lieu of an EIS under NEPA. The NPS has worked jointly with the U.S. Department of Transportation to develop an EEA, which is intended to identify the most desirable route across NPS lands and inform the development of terms and conditions to be included in the NPS ROW permit, which is currently suspended pending the current review process pursuant to the remand. Based on the findings and recommendations of the ANILCA Section 810 evaluation , the NPS could require additional terms and conditions in their ROW grant.

Alternatives

The purpose and need of the proposed action is a key factor in determining the range of alternatives required for consideration in an EIS and assists with the selection of a preferred alternative. For this Draft Supplemental EIS, the BLM and cooperating agencies re-examined alternatives concepts proposed during the previous EIS process and considered new alternatives concepts that could reduce overall potential impacts, especially impacts to subsistence use and resources, including habitat. After review and based on reconsideration of the screening analysis, the BLM retained the No Action Alternative, three route action alternatives, and one conceptual phasing alternative for detailed analysis in the Draft Supplemental EIS:

No Action Alternative. The No Action Alternative evaluates what would occur if the BLM does not grant a road ROW to AIDEA and no road is built. Federal agencies are required to evaluate taking no action as an alternative in an EIS. The No Action Alternative provides a baseline for comparison to the other alternatives, and it is a potential outcome of the EIS.

Alternative A: Alternative A is AIDEA's proposed route, beginning at Milepost (MP) 161 of the Dalton Highway and extending west along the southern flanks of the Brooks Range to the Ambler River within the District. It crosses GAAR. It would be 211 miles long, with 25 miles crossing BLM-managed land. The trip distance—Fairbanks to the western road terminus—would be 456 miles.

Alternative B: Alternative B is AIDEA's proposed alternative route to the Dalton Highway based on input from the NPS to minimize the amount of NPS land crossed and to avoid large waterbodies. It is a variation on Alternative A, with the same termini. It dips southward near GAAR to cross the National Preserve farther south than Alternative A. It would be 228 miles long, with 25 miles crossing BLM-managed land. The trip distance—Fairbanks to the western road terminus—would be 473 miles.

Alternative C: Alternative C grew out of scoping comments on the original EIS that suggested a route in the Tanana, Hughes, Hogatza, and Kobuk area, and is being carried forward in this Supplemental EIS. The route begins at MP 59.5 of the Dalton Highway, passes through the Ray Mountains, and proceeds generally to the northwest to pass just north of Hughes and just west of Kobuk. It terminates at the Ambler River within the District. It would be 332 miles long, with 274 miles crossing BLM-managed land. The trip distance—Fairbanks to the western road terminus—would be 476 miles.

Combined Phasing Option for all Action Alternatives: The combined phasing option applies to all of the action alternatives (Alternatives A, B, and C) and would require construction to occur in a 2-phased approach, as opposed to the 3-phase approach proposed by AIDEA. This option would eliminate Phase 1 and would initially build the entire road to Phase 2 standards. Under this option, the first road constructed would be 4 feet wider than Phase 1, as described under the action alternatives. Additionally, it would have a thicker road embankment that would provide more insulation to mitigate potential impacts to permafrost, water quality, and fish as compared to the roadbed associated with Phase 1 of the action alternatives. Much of the infrastructure required for Phase 2 standards of construction is the same as Phase 1, so infrastructure requirements for culverts and bridges for this option would be the same as the action alternatives.

Cumulative Impacts: Relationship of the Road Project to Potential Mine Projects

AIDEA's proposed project is an industrial access road project to a mining district. However, there is no formal development proposal for any specific mine at this time. Therefore, no federal agency is currently considering any authorization for mining development in the District. The only authorization to be decided at this time is for the road and its supporting infrastructure described in Draft Supplemental EIS Chapter 2, Alternatives. Actual mine developments would require federal permits and would be evaluated in separate environmental review processes at the time they are formally proposed.

This Draft Supplemental EIS addresses reasonably foreseeable mine development as indirect and cumulative impacts. The anticipated development is based on limited available information about the District and on the development of other similar mineral deposits. The reasonably foreseeable mining scenario is evaluated in the Draft Supplemental EIS as part of indirect and cumulative impacts (i.e., impacts induced by construction of the road and added to impacts of the proposed road). See Appendix H, Indirect and Cumulative Scenarios, for a detailed description of the reasonably foreseeable mining scenario.

The mining scenario assumes the 4 leading prospects in the District—Arctic, Bornite, Sun, and Smucker—all develop with a combination of open pit and underground mining. Other future mining development in the District is possible but is too speculative to include within the mining scenario for

detailed analysis. The mining scenario includes estimated amounts of ore processed; minerals extracted; jobs created; and road, rail, and ship traffic generated. Effects of this activity and other reasonably foreseeable actions are evaluated under each resource in Section 3, Affected Environment and Environmental Consequences, of this Supplemental EIS.

Scoping and Issues

The BLM undertook a scoping process for the Supplemental EIS from September 20 to November 4, 2022, to obtain information from potentially affected communities, Tribal entities, and the public at large regarding the scope of the analysis, potential alternatives, and identification of relevant information and studies to help determine which additional impacts and resources should be more thoroughly assessed. The scoping process and its full results appear in the Scoping Summary Report (Appendix K). The BLM also held an alternatives development and scope of analysis workshop with cooperating agencies on May 9–10, 2023.

The key issues addressed in this Supplemental EIS are the following:

- **Access.** Members of the public and some cooperating agencies expressed concern over the potential effects of trespass along the private road on subsistence use and cultural resources and the effects of possible future authorized public use on the region. While the road would not be open to the general public by design, public use and trespass are reasonably expected to occur and were analyzed in this Supplemental EIS in the context of indirect and cumulative impacts in Chapter 3. See Appendix H, Section 2.2, Road Access Scenarios for assumptions regarding commercial use, public and non-industrial use, and trespass.
- **Mining impact.** The Supplemental EIS addresses consequences of a reasonably foreseeable mining scenario as part of indirect and cumulative impacts. See Appendix H and analysis under each resource in Chapter 3, Affected Environment and Environmental Consequences, of the Draft Supplemental EIS.
- **Cultural resources.** The BLM has taken a programmatic approach to addressing cultural and historic resources under Section 106 of the National Historic Preservation Act and has developed a Section 106 Programmatic Agreement (Appendix J) in consultation with agencies and Tribal entities. Cultural resources are addressed in Section 3.4.8.
- **Subsistence Uses and Resources.** Subsistence uses and resources are addressed in Section 3.4.7 and Appendices L and M of the Draft Supplemental EIS. The Supplemental EIS also addresses mammals in Section 3.3.4, fish and aquatic species in Section 3.3.2, and socioeconomics (including public health) in Section 3.4.5.
- **Caribou**. The Supplemental EIS includes additional analysis of impacts to caribou forage vegetation, migration of the herd, and displacement in Section 3.3.4, Mammals.
- **Water Resources and Fish**. The Supplemental EIS includes additional analysis of impacts to water quality in Section 3.2.5, Water Resources, and associated impacts to fish populations, spawning areas, and aquatic habitat in Section 3.3.2, Fish and Aquatics.

Primary Impacts in the Supplemental Environmental Impact Statement

Appendix C (Chapter 2 Alternatives Tables and Supplemental Information), Table 2-2, and associated text, summarizes the key impacts of the project.

In general, Alternatives A and B share an alignment across the project area except within GAAR. Alternative B is 17 miles longer than Alternative A. Alternative C follows an almost entirely separate

alignment, crosses different terrain, and runs approximately 50 percent longer (332 miles) than the other alternatives. While the driving distance to Fairbanks would be similar, the longer road construction length means correspondingly greater acreage of impacts to vegetation, wildlife habitat, and wetlands; greater impacts to streams and wildlife movements; and greater uses of various tracts of (almost exclusively) public or Alaska Native corporation lands. Alternative C also would have greater effects on the Ray Mountains Herd and moose as well as greater involvement with discontinuous permafrost. Alternatives A and B could have greater effects related to sheefish habitat, the Western Arctic Herd (WAH), and potential use of mineral materials containing naturally occurring asbestos (NOA). Alternative A would cross the National Preserve for 26 miles. Alternative B would cross the National Preserve for 18 miles. Alternative C would not cross the National Preserve.

Air and water quality and water flows would be altered along the corridor compared to current, mostly natural conditions. Thousands of culverts would channel flowing water under the road and would affect natural flow patterns, erosion patterns, natural channel migration, ponding, and flooding patterns. Construction could hasten thawing of permafrost in localized areas and could damage natural topography and alter water flows and vegetation patterns. This is somewhat more likely under Alternative C than under Alternative A or B because Alternative C crosses discontinuous permafrost where the temperature of the permafrost is already closer to the thaw point. All alignments cross areas of NOA and rock that can generate acidic runoff when disturbed, although the Alternative C alignment crosses less area of high NOA potential. Either can be harmful to the environment and human health. Gravel materials containing NOA may be used in the construction of the road embankment where alternative materials are not readily available. AIDEA has committed to following State of Alaska requirements for use of gravels containing NOA in construction projects. No alternative would be expected to generate emissions of air pollutants, including dust, at levels that would approach or exceed National Ambient Air Quality Standards. However, all action alternatives would result in emissions due to combustion for movement of vehicles, heating maintenance camps and buildings, and generating power at maintenance camps and for communications facilities. GHG emissions would result from vehicle and equipment combustion during construction, and from road use once construction was complete. The annual cumulative GHG emissions from ore transportation would range from 51,972 CO_2e in metric tons/year under Alternative C to 55,835 CO_2e in metric tons/year under Alternative B.

All action alternatives would result in impacts to vegetation; wetlands; and fish, bird, and mammal habitats. Besides direct fill in wetland and vegetation habitat due to road construction, the areas near the road would be affected by road dust, noise, movement, and light or shading (at culverts and bridges), and potentially spills of pollutants from truck traffic. The road would impact fish habitat and alter free fish passage based on likely changes to channels, flows, sedimentation, and other changes to the water resource caused by culverts, bridge piers, alteration of surface and subsurface flow patterns, and other effects. Nonpoint-source pollutants in runoff and from dust as well as spills or leaks of toxic material could affect fish health and could damage spawning and rearing habitat. There are few known sheefish spawning areas in Alaska, and 2 are in the project area. Alternatives A and B would cross multiple streams upstream of these spawning areas, with Alternative B closest at 7 miles upstream. Alternative C would cross downstream of these spawning areas.

The road would fragment wildlife habitat. Caribou migration patterns and movements of other wildlife would be affected by the presence of a road and road noise. Alternative A would impact fewer acres of WAH caribou habitat (4,161 acres) compared to Alternative B (4,775 acres). Alternative C would impact 4,120 acres of WAH habitat. For all alternatives, approximately half of the habitat loss would be from peripheral habitat. Alternative C would use approximate one-third the area of migratory habitat (419 acres) compared to Alternatives A (1,287 acres) and B (1,347 acres). The presence of a road and road noise would affect caribou migration patterns and movements of other animals. Changes in migration

could alter where caribou spend their winters and summers; affect energy expenditure of the animals; and, with other herd pressure from other developments and climate change, could affect calving and survival rates.

Social impacts, including to subsistence and communities, would be of the same type for all action alternatives. However, different communities would be affected depending on the alternative. Kobuk, Shungnak, and Ambler would be affected by all alternatives, with direct road connection to Kobuk anticipated to develop with changes related to less expensive delivery of fuel, groceries, and construction materials likely. Alternatives A and B would be more likely to affect Bettles and Evansville, while Alternative C would affect Hughes (with a future road or year-round trail connection anticipated to develop from Hughes to the proposed Ambler Road). Alatna and Allakaket lie between the Alternative A and B and Alternative C alignments and likely would be affected by any action alternative, but to lesser degrees than closer communities. Subsistence use would be altered by the presence of a road. Impacts to subsistence and public health, including stress, subsistence-food insecurity, and potential exposure to toxins from road and mine operations would disproportionately affect low-income and minority populations, specifically Alaska Native villages in and near the project area that depend on the surrounding area for their subsistence lifestyle. Impacts to employment would occur but would not be expected to disproportionately benefit low-income and minority populations. Communities could benefit from road construction and maintenance jobs, and ultimately from new mining jobs. Because of its longer length and higher cost, Alternative C would generate more construction and operations and maintenance jobs.

The subsistence study area for the Ambler Road Supplemental EIS includes 66 communities that harvest subsistence resources within or near the project area, use the project area to access subsistence use areas, or harvest resources that migrate through the project area and are later harvested elsewhere. There are 16 communities with subsistence use areas that overlap the alternatives. Subsistence use would be altered by the presence of a road, both because a road would affect wildlife behavior and because it would bisect travel routes used by hunters and affect their access to subsistence use areas. Seven subsistence communities would have 5 or more of their subsistence use areas impacted by the road under Alternatives A and C; 8 communities would be affected at this level under Alternative B. Besides Kobuk, Shungnak, and Ambler, which would be similarly affected under all action alternatives, Alternative A would affect Bettles, Coldfoot, Evansville, and Wiseman; Alternative B would affect Alatna, Bettles, Coldfoot, Evansville, and Wiseman; and Alternative C would affect Alatna, Allakaket, Hughes, and Stevens Village. Under all alternatives, other communities would also be affected but with fewer subsistence areas involved. The road and mines could cause individual and community impacts related to collection of traditional foods. Migratory changes for WAH caribou are likely under all action alternatives, but would be greater under Alternatives A and B compared to Alternative C. Cumulative impacts of Alternative A and B related to resource abundance and availability would likely be greater than those under Alternative C.

Recreation and tourism are closely related to wilderness values in the area. Opportunities for solitude along the corridor would be affected whether backpacking, rafting, fishing or hunting by floatplane or motorboat, or going to traditional fish camps from nearby communities. The area sees limited use by people from outside the study area compared to road-accessible lands, but of the recreation/tourism trips that occur, many begin in GAAR and involve floating out of the Brooks Range to downstream communities or places where aircraft can get in to fly people out. Visitors would pass under Alternative A and B bridges midway through their multi-day trips, often trips that started on a designated wild and scenic river (designations end where the rivers flow out of GAAR). Visual and noise impacts would affect the experience. Two existing fly-in lodges that market their remote locations would be near the Alternative A and B alignments, and the visitor experience could be altered. However, the lodges and

communities may have potential for commercial delivery of materials and supplies by road, likely for transfer by snowmobile or boat to their end destination.

Proposed Measures to Reduce Impacts

AIDEA has committed to avoidance, minimization, and mitigation through design features proposed in their application and through subsequent responses to requests for information from the BLM (see Section 2.4.4, Design Features Proposed by AIDEA). The BLM assumed those commitments would be carried through in their analysis of effects in the Supplemental EIS, regardless of land ownership. The BLM has taken into consideration comments received during scoping and preparation of the Draft Supplemental EIS from communities, Tribal entities, non-governmental organizations, agencies, and the general public to fully understand and resolve issues to the extent possible and to avoid, minimize, or mitigate environmental impacts. Required mitigation will be documented in the ROD. Appendix N identifies potential mitigation measures. Due to only a portion of each alternative being located on BLM-managed land, the BLM's authority to require and enforce specific measures is limited.

This Draft Supplemental EIS does not discuss avoidance, minimization, or mitigation for impacts related to the development and operations of potential future mines in detail because specifics of that development are not sufficiently available at this time. However, each mine would be required to undergo its own environmental and permit analysis and state and federal agencies would consider mitigation based on the proposed mine plans prior to authorizing those developments.

ANILCA Section 810 Analysis

The BLM has found in its subsistence evaluation that Alternatives A, B, C, and the cumulative case considered in this Draft Supplemental EIS may significantly restrict subsistence uses in multiple communities. According to the ANILCA Section 810 evaluation (Appendix M), Alternatives A and B may significantly restrict subsistence uses for the communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Deering, Elim, Evansville, Golovin Hughes, Huslia, Kiana, Kivalina, Kobuk, Kotzebue, Koyuk, Noatak, Nome, Noorvik, Point Hope, Point Lay, Selawik, Shaktoolik, Shishmaref, Shungnak, Unalakleet, Wainwright, White Mountain, and Wiseman. For Alternative C, subsistence uses may be significantly restricted for the communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Deering, Elim, Evansville, Golovin, Hughes, Huslia, Kiana, Kivalina, Kobuk, Kotzebue, Koyuk, Noatak, Nome, Noorvik, Point Hope, Point Lay, Selawik, Shaktoolik, Shishmaref, Shungnak, Stevens Village, Unalakleet, Wainwright, White Mountain, and Wiseman. Generally, the restrictions may occur because of a potential decrease in abundance and availability of caribou, fish, and vegetation. For some communities, the road may restrict community access to subsistence resources. All communities may not experience impacts equally to all resources. However, the proposed road project may significantly impact at least 1 key subsistence resource for each community named above. None of the alternatives would result in a significant restriction to subsistence uses for the other communities examined: Alakanuk, Anvik, Atqasuk, Beaver, Brevig Mission, Emmonak, Galena, Grayling, Holy Cross, Kaltag, Kotlik, Koyukuk, Livengood, Manley Hot Springs, Marshall, Minto, Mountain Village, Nenana, Nulato, Nunam Iqua, Pilot Station, Pitka's Point, Rampart, Ruby, Russian Mission, St. Mary's St. Michael, Stebbins, Tanana, Teller, and Wales. The cumulative case examined in Appendix H may further restrict subsistence uses for the communities of Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Buckland, Coldfoot, Deering, Elim, Evansville, Golovin, Hughes, Huslia, Kiana, Kivalina, Kobuk, Kotzebue, Koyuk, Noatak, Nome, Noorvik, Nuiqsut, Point Hope, Point Lay, Selawik, Shaktoolik, Shishmaref, Shungnak, Stevens Village, Unalakleet, Utqiagvik, Wainwright, White Mountain, and Wiseman. See Appendix M for additional details.

Because there may be a significant restriction on subsistence use, the BLM has undertaken the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2) in conjunction with release of the Draft Supplemental EIS to solicit public comment from the potentially affected communities. The BLM will ensure that testimony on impacts to subsistence, acquired from the hearings held in affected communities, is included in the analysis of alternatives in the Final EIS. Additionally, the ANILCA Section 810 Evaluation (see Appendix M) may be revised to include testimony and/or mitigation measures suggested by or created from public testimony. The ROD will briefly summarize the evaluation, findings, notice given, hearings held, and final determinations for the selected alternative, including determinations resulting from analysis of cumulative effects of the selected alternative.

1. Introduction

1.1. Introduction*

The Bureau of Land Management (BLM) Fairbanks District Office has prepared this Draft Supplemental Environmental Impact Statement (Draft Supplemental EIS) to consider the environmental effects of issuing federal authorizations in response to a right-of-way (ROW) application from the Alaska Industrial Development and Export Authority (AIDEA). To assist readers in identifying new information in this Draft Supplemental EIS, new or substantially revised text is highlighted in light yellow (as shown in this paragraph). Substantial revisions include changes to the text or underlying data that have changed the analysis or analysis conclusion. All sections that are new or include significant or substantial revisions include an asterisk (*) at the end of the section heading; all new or substantially revised tables and figures also include an asterisk at the end of the table title or figure caption.

AIDEA proposes to construct; operate and maintain for an estimated 50 years; and to remove a 211-mile, all-season, industrial access road to the Ambler Mining District (District)[1] in the Brooks Range of Alaska (Volume 4, Maps, Map 1-1). Under AIDEA's proposal, approximately 25 miles of the proposed road would cross BLM-managed lands. According to AIDEA, the road would provide access for mineral exploration, mine development, and mining operations in the Ambler Mining District (District). AIDEA is a State of Alaska (State) public corporation whose mission is to increase job opportunities and economic activity in the state. AIDEA has undertaken similar efforts, such as the industrial road that provides access to Red Dog Mine from the northwest coast of Alaska.

On November 24, 2015, and supplemented on June 20, 2016, AIDEA filed a ROW application (known as Standard Form 299 [SF 299]) for surface transportation access to currently road-inaccessible mineral deposits in the District (DOWL 2016a). AIDEA filed the application in accordance with the provisions in the Alaska National Interest Lands Conservation Act (1980) (ANILCA) for providing access to the District (see ANILCA Sections 201(4)(b) and 1101(a)). On April 29, 2019, AIDEA submitted to the BLM an amendment to the SF 299, which addresses communications facilities associated with the proposed access road (DOWL 2019a). On October 29, 2019, AIDEA submitted comments on the Draft EIS to the BLM that included clarifications and details on design commitments. On November 13, 2019, AIDEA submitted information about project financing, proposed road maintenance, and proposed reclamation details to the BLM that identified additional design features.

On February 5, 2020, AIDEA submitted a revised Application for Department of the Army Permit to the Alaska District of the U.S. Army Corps of Engineers (USACE) pursuant to the Rivers and Harbors Act (RHA) Section 10 and Clean Water Act (CWA) Section 404, among others, which included a revised permit application narrative.

These federal authorizations for the Proposed Ambler Mining District Industrial Access Project (Ambler Road) were originally analyzed in the March 2020 Final EIS and authorized in a joint Record of Decision (JROD) issued in July 2020 by the BLM and the USACE. Litigation commenced with suits from multiple parties in August and October 2020. In February 2022, the U.S. Department of the Interior (DOI) requested the U.S. District Court for Alaska grant voluntary remand, stating that additional legal analysis revealed deficiencies in the BLM's analysis of subsistence impacts under ANILCA Section 810 and

[1] The term "Mining District" applies traditionally to geographic areas described by miners, and such districts are often governed under bylaws drawn up by miners. The Ambler Mining District, however, is an informal descriptive term applied to the approximate area mapped in this Draft Supplemental EIS and has no formal or legal standing. In contrast, the many individual mining claims and mining agreements that exist within the mapped area do have legal rights and responsibilities under state and federal law (Pearson 2016; mindat.org 2019).

consultation with Tribes pursuant to Section 106 of the National Historic Preservation Act (NHPA). In addition, the DOI stated it intended to supplement the National Environmental Policy Act (NEPA) analysis on remand. The court granted that request in May 2022, returning the matter to the BLM to correct the identified deficiencies. This supplemental analysis will address deficiencies identified during the litigation process.

The BLM has authority to grant land use authorizations across BLM-managed lands and is the lead agency for this Draft Supplemental EIS. The BLM has prepared this Draft Supplemental EIS in compliance with NEPA, the Council on Environmental Quality regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), BLM NEPA Handbook H-1790-1 (BLM 2008a), and other applicable laws and regulations. As discussed further in Section 1.2.2, Project Development Background and History, a portion of AIDEA's proposed route goes through the National Preserve unit of the Gates of the Arctic National Park and Preserve (GAAR), managed by the National Park Service (NPS). As required in ANILCA, the NPS developed an Environmental and Economic Analysis (EEA) to determine the route through GAAR and develop terms and conditions for issuance of the NPS ROW grant. Impacts to GAAR are addressed both in this Draft Supplemental EIS and in greater depth in the NPS EEA.

The following Appendices (Volumes 1 through 3) are included in this Draft Supplemental EIS:

- Appendix A: Figures
- Appendix B: Chapter 1 Introduction Tables and Supplemental Information
- Appendix C: Chapter 2 Alternatives Tables and Supplemental Information
- Appendix D: Chapter 3 Physical Environment Tables and Supplemental Information
- Appendix E: Chapter 3 Biological Resources Tables and Supplemental Information
- Appendix F: Chapter 3 Social Systems Tables and Supplemental Information
- Appendix G: Alternatives Development Memorandum
- Appendix H: Indirect and Cumulative Scenarios
- Appendix I: Collaboration and Consultation
- Appendix J: Section 106 Programmatic Agreement
- Appendix K: Final Scoping Report for the Ambler Road SEIS
- Appendix L: Subsistence Technical Report
- Appendix M: ANILCA Section 810 Draft Evaluation
- Appendix N: Potential Mitigation
- Appendix O: References
- Appendix P: Glossary

1.2. Project Background and Overview*

1.2.1 Summary of Applicant's Proposed Action and Land Status*

AIDEA has proposed an all-season industrial access road. See Chapter 2, Section 2.3.1, Modes and Concepts Eliminated, at the subheading Public Access Road versus Industrial Access Road. The proposal includes bridges, material sites, maintenance stations, airstrips, and related infrastructure and utilities (see

Chapter 2, Alternatives, of this Draft Supplemental EIS). AIDEA proposed building this road in phases, starting with a seasonal, single-lane, gravel pioneer road (Phase 1). This road would be expanded in Phase 2 to a wider all-season, single-lane gravel road and later further expanded to a 2-lane gravel road in Phase 3. In their application (DOWL 2016a), AIDEA projected the road to have a life of approximately 50 years, based on an estimate of when mineral exploration and development in the District is anticipated to be completed. AIDEA's proposal calls for removal of the road and reclamation and restoration of the ROW upon cessation of mining activities in the District, although notes that no detailed reclamation plan has been developed and it does not intend to do so until close to road closure (in 50 years). AIDEA intends for the access road to facilitate further mining exploration and development. However, AIDEA has not directly proposed mining-related development in the District. Others would pursue the mining activities, which would require separate permitting decisions and, presumably, NEPA review.

The BLM was informed by AIDEA that all aspects of the original application remain valid and that there are no substantive changes to the requested route, construction techniques, ancillary facilities, or other features as described in the 2016 application.

AIDEA's proposed route includes federal, state, Native, and other private lands, including individual Native allotments (see Volume 4, Map 2-3, pp. 1, 2, and 3). Several communities are located near or adjacent to the proposed route (see Volume 4, Map 1-1). These communities harvest resources from lands and waters that the route traverses (see Appendix L), and the area contains key habitat for salmon and sheefish, as well as caribou, especially the Western Arctic Herd (WAH), and is used for recreation, especially where it overlaps with GAAR and the Kobuk Wild and Scenic River (see Volume 4, Maps 3-17, 3-18, 3-21, and 3-29).

1.2.2 Project Development Background and History*

The State, through AIDEA, is proposing the access road in accordance with the access provisions of ANILCA and based on studies conducted by the Alaska Department of Transportation and Public Facilities (DOT&PF) and AIDEA. With funding from the Alaska Legislature, DOT&PF began to identify and evaluate alternative overland routes in 2009 and produced a series of reports in 2011 and 2012. DOT&PF transferred the project to AIDEA in 2013. In its application materials, AIDEA identified a proposed route and an alternative route (see Volume 4, Map 1-1). The portion of the road that would cross BLM-managed lands is identical under AIDEA's proposed and alternative routes.

A portion of AIDEA's proposed route goes through GAAR, managed by the NPS. In ANILCA Section 201(4)(b), Congress anticipated the need for surface transportation access across GAAR from the District to the Alaska Pipeline Haul Road (Dalton Highway). Per ANILCA, this access through GAAR is subject to alternative review in lieu of a NEPA EIS.[2] ANILCA directs the Secretaries of the DOI and the U.S. Department of Transportation (USDOT) to jointly prepare an EEA to determine the most desirable route through GAAR, in accordance with other provisions, and develop possible terms and conditions for

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[2] ANILCA 201(4): "(b) Congress finds that there is a need for access for surface transportation purposes across the Western (Kobuk River) unit of the Gates of the Arctic National Preserve (from the Ambler Mining District to the Alaska Pipeline Haul Road) and the Secretary shall permit such access in accordance with the provisions of this subsection. (c) Upon the filing of an application pursuant to section 1104 (b), and (c) of this Act for a right-of-way across the Western (Kobuk River) unit of the preserve, including the Kobuk Wild and Scenic River, the Secretary shall give notice in the Federal Register of a thirty-day period for other applicants to apply for access. (d) The Secretary and the Secretary of Transportation shall jointly prepare an environmental and economic analysis solely and for the purpose of determining the most desirable route for the right-of-way and terms and conditions which may be required for the issuance of that right-of-way. This analysis shall be completed within one year and the draft thereof within nine months of the receipt of the application and shall be prepared in lieu of an environmental impact statement which would otherwise be required under section 102(2)(C) of the National Environmental Policy Act. Such analysis shall be deemed to satisfy all requirements of that Act and shall not be subject to judicial review. Such environmental and economic analysis shall be prepared in accordance with the procedural requirements of section 1104(e) . . . ."

issuance of the NPS ROW grant. However, ANILCA included no waiver from NEPA for granting access across BLM-managed lands. Also, compliance requirements under other acts (e.g., CWA) were not exempted.

The DOI (through the NPS) and USDOT (through the Federal Highway Administration [FHWA]) finalized the EEA in July 2020, and a route decision was issued concurrently with the BLM and USACE JROD in 2020. Both the BLM and the NPS ROWs have been suspended while this Supplemental EIS is being prepared.

1.2.3 Ambler Mining District and Land Status*

The District is located within the Northwest Arctic Borough (NAB), in the southern foothills of the Brooks Range of Northcentral Alaska. There is currently no road or other surface transportation access to this region from the existing transportation network. Volume 4, Map 1-1 shows the location of the District as identified by AIDEA in its SF 299 ROW application (DOWL 2016a) and an area of concentrated mining claims referred to as the Ambler Mineral Belt, as indicated in map 1-1.

The District contains a variety of communities and natural resources, including mineral deposits. The deposits have been explored or evaluated for more than a century (DOWL 2016a; Grybeck 1977; USGS 1983). The applicant has identified and independent studies confirm the presence of copper, lead, zinc, silver, and gold on site (DOWL 2016a; USGS 1983, 1988 and 1996). There are more than 1,700 active mining claims in the District, primarily in the mineral belt (ADNR 2023). A 2015 economic analysis identified 4 major mineral deposits, with Ambler Metals' (formerly Trilogy Metals, Inc.) Arctic and Bornite deposits the most active (Cardno 2015). More information on mining claims and potential is found in Section 3.2.1, Geology and Minerals; Section 3.4.1, Land Ownership, Use, Management, and Special Designations; and Appendix H, Indirect and Cumulative Scenarios.

The District boundary also includes federal, state, Native, and other private lands, including individual Native allotments (see Volume 4, Map 2-3 pages 2 and 3). The Ambler Mineral Belt is located on state lands and comprised of state mining claims (see Volume 4 Map 3-25). Two communities are located within the District, Shungnak and Kobuk, with Ambler located approximately 10 miles to the west. All three communities, as well as Anaktuvuk Pass, Kotzebue, Noatak and Selawik harvest resources from lands and waters within the District (see Appendix L). The District contains salmon and sheefish spawning habitat, migratory and overwintering habitat for the WAH, and is used for recreation, especially where it overlaps with Gates of the Arctic National Preserve and the Kobuk National Wild and Scenic River (see Volume 4, Maps 3-17, 3-18, 3-21, and 3-29).

1.3. Applicant's Goals for the Project*

AIDEA is pursuing construction of an industrial access road consistent with its mission to increase job opportunities and otherwise encourage the State's economic growth, including development of natural resources (AIDEA 2019). Specifically, AIDEA's goal for this project is to support mineral resource exploration and development in the District. The road would provide surface transportation access to the District and allow for expanded exploration, mine development, and mine operations at mineral prospects throughout the District. AIDEA indicates that surface transportation access would help bring the high-value mineral resource areas into production (DOWL 2016a).

AIDEA lists multiple public benefits related to the project goal, including direct employment for road construction and operation, indirect employment related to mining, revenues paid to local and state governments and Alaska Native corporations, and commercial access opportunities for nearby communities associated with proximity to a road (DOWL 2016a).

After confirming that the applicant's goals for the project have not changed since, the BLM determined that its purpose and need for the proposed action, as articulated in this Supplemental EIS, remained accurate.

1.4. Purpose and Need for Federal Action*

The BLM reviewed its purpose and need from the March 2020 Final EIS and determined that no substantive changes were needed. The BLM is responding to an application for a ROW under Title V of the Federal Land Policy and Management Act (FLPMA) for year-round industrial surface transportation access across BLM-managed lands to the District. The BLM will decide whether to grant, grant with modifications, or deny the applicant's ROW application. In making its determination, the BLM will consider incorporating appropriate terms and conditions in any decision to approve the ROW.

The U.S. Army Corps of Engineers (USACE) is a cooperating agency for this project and also has its own purpose and needs to consider. Under Section 404(b)(1) Guidelines, the USACE has a *basic purpose* to determine whether the proposed project is water-dependent. Then, the USACE has an *overall purpose* that, based on AIDEA's purpose and need, serves as the basis for identifying practicable alternatives to the applicant's proposed project. In its review as a cooperating agency, the USACE indicated that its *overall purpose* is "to provide year-round surface transportation access for mining exploration and development in the Ambler Mining District." The BLM confirmed with the USACE that its purpose and need for the proposed action had not substantively changed since the March 2020 Final EIS.

1.5. Collaboration and Coordination*

1.5.1 Key Agency Participation*

Lead Federal Agency

The BLM is the lead federal agency for this Draft Supplemental EIS. In addition to NEPA, the BLM is leading the analysis under ANILCA Section 810, National Historic Preservation Act (NHPA) Section 106, and Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act. ANILCA Section 810 requires evaluation of the project's effects on subsistence resources and access to those resources where the project would use federal public land. NHPA Section 106 requires consideration of the project's effects on historic properties and applies to the entire route, regardless of land status. The Magnuson–Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in federal waters, and Essential Fish Habitat is defined under that Act as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Cooperating Agencies

Other federal agencies are cooperating agencies because they have their own federal authorization decisions that require compliance with NEPA and/or they have special expertise. These agencies will use this Supplemental EIS as a basis for their decisions:

- **U.S. Army Corps of Engineers.** The USACE has jurisdiction over activities that would include the discharge of dredge or fill material into waters of the United States (WOTUS), including wetlands (as regulated under CWA Section 404), and work or structures constructed in, on, over, or under navigable waters (as regulated under RHA Section 10).
- U.S. **Fish and Wildlife Service (USFWS).** The USFWS is participating as a cooperating agency due to the agency's expertise related to fish and wildlife.

- **U.S. Environmental Protection Agency (EPA).** The EPA is participating as a cooperating agency to maximize use of available resources and special expertise, and minimize duplication in those areas of overlapping responsibilities.

Non-federal cooperating agencies for this Supplemental EIS with jurisdiction by law and/or because they have special expertise include:

- **State of Alaska.** The Alaska Department of Natural Resources (ADNR) Office of Project Management and Permitting is serving as the lead State agency to coordinate input for the State from other State agencies, including the Alaska Department of Environmental Conservation (ADEC); Alaska Department of Fish and Game (ADF&G); Alaska Department of Health and Social Services; and Alaska Office of History and Archaeology, State Historic Preservation Officer. The ADF&G has expertise related to fish and wildlife and its overall fish and wildlife management responsibilities. The ADNR would make land management decisions for ROW access across State-managed lands.
- **Federally Recognized Tribes.** Alatna Village Council, Evansville Tribal Council, Huslia Tribal Council, and Tanana Tribal Council are cooperating agencies for their special expertise related to traditional knowledge and input on subsistence and cultural resources.

Participating Agencies

The NPS is a participating agency in the development of this Supplemental EIS to coordinate it with their EEA.

1.5.2 Cooperating Agency Engagement*

The BLM and cooperating agencies met regularly throughout the development of the 2020 EIS to discuss topics, including data sharing, determining methods for impact analysis, and discussing purpose and need, screening criteria, and alternatives development. For this Supplemental EIS, the BLM held a cooperating agencies' alternatives development and scope of analysis workshop on May 9–10, 2023. The BLM and cooperating agencies re-examined alternatives concepts that were proposed during the previous EIS process and considered new alternatives concepts that would reduce overall potential impacts, especially impacts to subsistence uses and resources. Cooperation in the preparation of this Supplemental EIS does not necessarily mean that that the cooperating agencies will agree with the BLM's decision.

1.5.3 Government-to-Government and National Historic Preservation Act Section 106 Consultation with Tribes*

At the initiation of the previous EIS process, the BLM conducted a review of potentially affected federally recognized Tribes along the proposed and alternative road corridors and identified those Tribes that could be indirectly affected. Based on this review, on April 20, 2017, the BLM sent letters to 52 federally recognized Tribes, presenting the opportunity for government-to-government (G2G) consultation on the project. The BLM undertook ongoing communications and outreach throughout the previous NEPA process. This involved sending letters to Tribes, notifying them of the NEPA and Section 106 processes and offering the opportunity for G2G consultation. Tribes were also invited to become cooperating agencies and participate in EIS development (8 cooperating agency meetings were held). The BLM also created a project email list that included email contacts for Tribal representation for the study area and provided email updates at multiple stages. During scoping for the previous EIS, the BLM held an extended scoping period and conducted meetings in 8 villages and 2 teleconferences with the Western Arctic Caribou Herd Working Group (WAH WG) to provide opportunities for Tribes and rural communities to share comments or concerns. During the previous Draft EIS comment period, the BLM

held 18 hearings/open house meetings in potentially affected villages and 11 G2G consultation meetings. The BLM also held 3 Section 106 consultation meetings and invited Tribes to participate to discuss concerns, share information, and review and comment on the draft Programmatic Agreement (PA).

The BLM initiated Section 106 consultation in 2017 for the initial EIS and sent letters to 109 entities across northwest Alaska, including Tribes, ANCSA corporations, local governments, and other interested parties inviting them to consult and/or share information or concerns about historic properties, cultural resources, or places of importance that could be impacted by the project. Through this consultation, the BLM developed a PA, which allows for a phased approach to complying with Section 106, pursuant to the implementing regulations found in 36 CFR 800. The BLM developed the PA through consultation with agencies, Tribes, and other interested parties and has provided opportunities for the public to share comments or information during the public scoping and comment periods (see Appendix J, Section 106 Programmatic Agreement).

Tribal consultation pursuant to the requirements of the Section 106 PA continued in 2021 and 2022, including soliciting review and comments related to AIDEA's annual reports, the required annual meeting to discuss the PA, and discussion pertaining to places of traditional cultural or spiritual importance. In June 2022, letters were sent to 23 Tribal PA Consulting Parties soliciting consultation meetings regarding the Section 106 process. Phone calls occurred to ensure the letters were received, to answer any questions, and to schedule consultation. From this outreach, meetings were held with the Village Councils of Alatna, Allakaket, Ambler, Hughes, and Kobuk. In November 2022, 80 letters were sent to Federally Recognized Tribes, Tribal Non-Profits, and Alaska Native Corporations to reinitiate the Section 106 Process per the DOI Remand. Follow-up phone calls occurred every two weeks for three months to all entities and follow-up emails were sent in December and January. Two additional Tribes were added as PA Consulting Parties and the BLM held 11 in-person G2G consultation meetings. Appendix I, Collaboration and Consultation, summarizes G2G consultation during the previous and current NEPA processes.

1.5.4 Alaska Native Claims Settlement Act Corporations

The Alaska Native Claims Settlement Act (1971) (ANCSA) formed Alaska Native regional and village corporations in Alaska. On April 20, 2017, the BLM sent letters to 4 regional corporations and 18 village corporations, initiating consultation for the project. Because Alaska Native corporations are not government entities, they cannot participate in the NEPA process as cooperating or participating agencies, nor are they considered federally recognized Tribes. However, Native corporations are afforded status as Tribes under NHPA Section 106, and as a matter of policy, the BLM initiates consultation with Alaska Native corporations for actions that have a substantial direct effect on them. These Alaska Native corporations own large areas within the project area and represent shareholders who are members of Tribes. The BLM actively engaged Alaska Native corporations during the development of the initial EIS and as part of this Supplemental EIS process (see Appendix I, Collaboration and Consultation).

1.5.5 Other Coordination

The BLM and AIDEA met regularly throughout the development of the initial EIS and for this Draft Supplemental EIS to discuss AIDEA's ROW grant application and to request additional information or clarification about AIDEA's proposed project. The BLM also presented to a number of other groups, including the WAH WG, Maniilaq Association, and local governments (see Appendix I, Collaboration and Consultation). The BLM also consulted with (1) the National Oceanic and Atmospheric Administration Fisheries regarding essential fish habitat in accordance with the Magnuson–Stevens Fishery Conservation and Management Act; (2) the NPS regarding Wild and Scenic River impacts and coordination on other impacts and mitigation inside and outside of GAAR; and (3) the U.S. Fish and Wildlife Service regarding compliance with the Endangered Species Act.

1.5.6 Summary of Applicable Laws, Regulations, and Permits

Appendix B (Chapter 1 Introduction Tables and Supplemental Information), Table 1, summarizes key anticipated authorizing laws, regulations, and permits for the project. If a Record of Decision is signed by federal agencies approving an action alternative for this Supplemental EIS, AIDEA would be required to complete permitting through other agencies and landowners and comply with mitigation commitments identified in each agency's Record of Decision.

1.6. EIS Development Process and Coordination*

On February 28, 2017, the *Federal Register* published BLM's Notice of Intent to prepare the initial EIS for the Ambler Road Project, initiating a 90-day scoping comment period. The BLM later extended the comment period through January 31, 2018. The BLM reviewed and processed the comments received and published a scoping summary report on the project website in May 2018 (BLM 2018a). Based on scoping comments, the BLM updated the project purpose and need, developed screening criteria, and evaluated a full range of alternatives through a coordinated process with cooperating agency input to arrive at the reasonable alternatives evaluated in full in the initial EIS. Screening criteria are metrics used to evaluate and, ultimately, "screen out" alternatives that are not reasonable (i.e., those that do not meet the criteria). The Screening Criteria are further explained in Appendix G, Section 4.

BLM's Ambler Road EIS ePlanning webpage launched January 21, 2016. In October 2017, the BLM added a standalone Ambler Road EIS webpage (www.blm.gov/AmblerRoadEIS) to better enable visitors and search engines to find EIS information and direct people to the ePlanning webpage. These webpages provide background information, project documentation, and project team contact information.

The BLM published a Notice of Intent to prepare a Supplemental EIS on September 20, 2022. The scoping period for the Supplemental EIS was 45 days and ran from September 20, 2022, to November 4, 2022. The Supplemental EIS scoping period was announced in the *Federal Register*, local newspaper advertisements, radio announcements, postcard mailers to the mailing list, a BLM news release, and the Ambler Road ePlanning website.

1.6.1 Scoping and Key Issues*

Scoping is a formal process to help the BLM determine the scope of the analysis needed in the EIS. During scoping for the initial EIS, the BLM solicited input on potential issues, impacts, and alternatives to be addressed in the EIS. The BLM held 13 public scoping meetings and an agency scoping meeting in November and December 2017 (see Appendix I). The BLM held scoping meetings in Allakaket, Anaktuvuk Pass, Alatna, Fairbanks, Wiseman, Anchorage, Ambler, Kotzebue, Shungnak, Kobuk, Hughes, Huslia, and Evansville/Bettles. The BLM conducted other outreach during scoping, including presentations at various organizations' meetings. The final Scoping Summary Report (BLM 2018a) on BLM's project website (www.blm.gov/AmblerRoadEIS) provides further details.

The BLM received oral testimony at most of the public scoping meetings. Additionally, the BLM received a total of 7,225 written scoping communications. These included 6,343 form emails, 862 unique emails (93 of which included attachments), and 20 letters and faxes. The Scoping Summary Report organized these comments into broad issue categories, which included Project/Process, Physical Environment, Biological Environment, Social Environment, and Other Topics such as air quality/dust and impacts related to specific components of the project (e.g., construction camps, gravel pits; BLM 2018a).

The BLM received public comments that expressed concerns about the effects of a new road in a remote rural area. Impacts of highest concern were those related to subsistence resources, particularly caribou and fish, and to the subsistence and rural lifestyle in the area. Related concerns were about impacts to

wildlands, designated federal wilderness, wild and scenic rivers, and the broader ecosystem, as well as social impacts within nearby communities. While AIDEA has proposed the road for industrial use by permit, the potential for public access on the road was frequently mentioned, both as a potential benefit to local residents and businesses and as a potential adverse effect by spurring competition for subsistence resources by recreational hunters and fishers and introducing drugs and alcohol to dry communities. Many also expressed concerns about the impacts resulting from mining exploration and development in the District that the industrial access road is intended to promote. Supportive comment letters were also received, expressing support for jobs and the potential for reduced costs of living in the area, and outlining economic benefits from mining development.

Supplemental EIS Scoping

The scoping period for the Supplemental EIS was 45 days and ran from September 20, 2022, to November 4, 2022. The BLM received 18,977 written communications during the Supplemental EIS scoping period. These comments were submitted via the ePlanning website, email, or mailed-in letters. Of the comment letters, the majority (88 percent) were submitted as form letters (i.e., letters containing identical content). The 17,427 form letter submissions all originated from seven unique form master letters. The remainder were either form letters with slight modifications (8 percent) (e.g., 1 or 2 unique sentences added, but otherwise identical to a form letter) or unique comment letters (4 percent) (i.e., original letters that did not have identical or almost identical wording as another letter).

In total, 4,331 individual substantive comments were identified and categorized as summarized in the Ambler Road Supplemental Environmental Impact Statement Final Scoping Summary Report (BLM 2023). The five categories that received the most substantive comments were as follows:

1. Subsistence – 9.4 percent
2. Wildlife: Caribou – 7.6 percent
3. Socioeconomic and communities – 6.6 percent
4. Water resources – 6.0 percent
5. Analysis methods and data: Inadequate methodologies – 5.2 percent

Additional details concerning the content of comments and their key points are summarized in Table 2.4 of the Supplemental EIS scoping report (see Appendix K).

1.6.2 Draft EIS Review

The initial Draft EIS was published on August 30, 2019. The BLM provided a 60-day comment period and held meetings/hearings in 18 rural communities, 2 hub communities (Anchorage and Fairbanks), and Washington, DC (as required by ANILCA). The BLM offered numerous opportunities for area residents to weigh in with written comments, including through email, the BLM ePlanning website, comment forms at meetings, and oral testimony at the 21 hearings/meetings. See Appendix I, Collaboration and Consultation, for details on the hearing locations.

Notices for the public meeting dates were sent to the project mailing list; published in the *Federal Register*; advertised in area newspapers and on social media; published on the BLM project ePlanning website; posted on fliers in potentially affected villages; and aired via public service announcements on area radio stations. Multiple newspapers also ran stories publicizing the meetings. See Appendix I, Collaboration and Consultation, for details on the outreach publicizing the comment opportunities.

In addition to publishing the Draft EIS and the Geographic Information Systems data on the BLM ePlanning website, a printed copy of the Draft EIS was mailed to each affected community to be made available for review by members of the public. The documents were also made available at BLM public reading rooms in Anchorage, Fairbanks, and Washington, DC. Upon request, the BLM printed and mailed copies of the Draft EIS or provided copies on thumb drives.

The BLM received more than 29,000 communications, including unique letters, unique emails, comment forms, oral testimonies, form letters, and submissions to the ePlanning website. The BLM reviewed these communications, prepared responses to those comments identified as substantive, and updated the EIS document based on this input where appropriate. Appendix Q of the Final EIS (Substantive Comments and BLM Responses) includes a description of the public comment process, how the BLM considered all comments, and a summary of responses to select substantive comments. All substantive comments and their associated responses were posted on BLM's ePlanning website for the project (www.blm.gov/AmblerRoadEIS).

The comments submitted to the BLM during the Draft EIS comment period were similar to those received during scoping. Commenters expressed concerns regarding the effects of a new road through a remote, rural area; how the proposed road would impact subsistence resources, particularly caribou and fish, and the subsistence harvest and use and rural lifestyle in the project area. Other concerns include air quality; potential contamination from toxic substances; social and health impacts within nearby communities; public versus private use of the proposed road; the potential for public access on the road, including potential benefits and adverse effects; indirect and cumulative impacts resulting from mining exploration and development in the District that the industrial access road is intended to promote. The BLM also received supportive comment letters similar to those received during scoping. These focused primarily on economic benefits from mining exploration and development, including the potential for increased jobs, increased State and local revenue, and reduced costs of living in the project area.

1.6.3 Final EIS and Protest Period*

On March 27, 2020, a Notice of Availability of the now-remanded Ambler Road Final EIS was published in the *Federal Register* (85 FR 17353). The mandatory 30-day waiting period ended April 26, 2020. Comments on the Ambler Road Final EIS were not solicited. Comments received after the publication of the Final EIS on March 27, 2020, were considered during development of the JROD, which was issued in July 2020. Following the issuance of the JROD, litigation commenced with suits from multiple parties in August and October 2020.

1.6.4 Draft Supplemental EIS Review*

The BLM has prepared this Draft Supplemental EIS to help address identified deficiencies in the 2020 Final EIS and to ensure compliance with applicable law, including NEPA, the FLPMA, the NHPA, and ANILCA. This Draft Supplemental EIS analysis focuses on more thoroughly assessing the impacts and resources related to the identified deficiencies to facilitate integrating the NEPA analysis with the ongoing ANILCA Section 810 and NHPA Section 106 processes.

The BLM will provide for a 60-day comment period and will hold public meetings and hearings in the vicinity of affected communities, and in Anchorage and Fairbanks, Alaska. The BLM will provide numerous opportunities for area residents and other members of the public to weigh in with written comments, including through email, the BLM ePlanning website, comment forms at meetings, and oral testimony at the hearings/meetings.

Notices for the public meeting dates were sent to the project mailing list; advertised in area newspapers and on social media; published on the BLM ePlanning website; posted on fliers in potentially affected

villages; and aired via public service announcements on area radio stations. Multiple newspapers also ran stories publicizing the meetings.

In addition to publishing the Draft Supplemental EIS and the geographic information system (GIS) data on the BLM ePlanning website, a copy of the Draft Supplemental EIS will be mailed to each affected community via thumb drive to be made available for review by members of the public. The documents will also be made available at BLM public reading rooms in Anchorage and Fairbanks. Upon request, the BLM will print and mail copies of the Draft Supplemental EIS or provide copies on thumb drives.

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2. Alternatives

2.1. Introduction*

To identify the alternatives evaluated in detail in this Draft Supplemental EIS, the BLM reconsidered the range of alternatives analyzed in the original EIS. These include AIDEA's proposed alternative, two additional action alternatives (Alternatives B and C), and routes investigated by DOT&PF that were considered by the BLM but eliminated from further analysis. The BLM also considered comments received during scoping, including multiple comments related to alternatives and factors that fed into the alternative screening process (BLM 2018a, 2023). The BLM worked with cooperating agencies to determine whether any new information since publication of the Final EIS in 2020 warranted revisiting any of the alternatives previously eliminated from consideration or revising the existing action alternatives or would lead to potentially proposing a new alternative, including considering whether they were reasonable in light of the stated purpose and need. This chapter summarizes the results of that process (Section 2.2, Alternatives Development Process) and briefly describes why the BLM determined certain alternatives remained unreasonable (Section 2.3, Alternatives Considered but Eliminated from Detailed Analysis) to carry forward for a full evaluation. Section 2.4, Alternatives Retained for Detailed Analysis, details the No Action Alternative, AIDEA's proposed action (Alternative A), and reasonable alternatives to AIDEA's proposal (Alternatives B and C). Section 2.4.4, Design Features Proposed by AIDEA, describes certain design features proposed by AIDEA to mitigate adverse environmental impacts.

The BLM documented the alternatives development process in Appendix G, Alternatives Development Memorandum, which relied on relevant documents prepared by AIDEA, DOT&PF, and others to develop and screen alternatives (incorporated here by reference; see Appendix G bibliography). BLM's ePlanning website (www.blm.gov/AmblerRoadEIS) includes relevant supporting documents. Consult these documents for additional details regarding the alternatives and their evaluation.

2.2. Alternatives Development Process*

In developing alternatives for this Draft Supplemental EIS, the BLM first reviewed public comments that were submitted on the 2019 Draft EIS for any alternatives concepts that were previously excluded from detailed consideration but might now be relevant based on new information. The BLM and cooperating agencies re-examined alternatives concepts proposed during the previous EIS process and considered new alternatives concepts that could reduce overall potential impacts, especially impacts to subsistence use and resources, including habitat.

Alternatives options considered during the cooperating agencies' alternatives development workshop included the reasonableness of a road or railroad route to the west, terminating at a port site in Nome; alternative modes of transportation that could be used to support exploration, including aircraft or ice roads; combining the proposed phases of construction; an alternative that consists of a road and a double pipeline (for fuel and flotation concentrate slurries) corridor adjacent to the road; and an alternative that was proposed during scoping for the Supplemental EIS by Tanana Chiefs Conference (TCC) that was referred to as the Tribal Alternative.

The BLM held a 45-day public scoping comment period to solicit public input on the Ambler Road Supplemental EIS. Commenters suggested that the BLM expand their list of alternatives to include a transportation corridor that travels west to the Bering Sea, not east to the Dalton Highway; a railroad corridor that may or may not be spurred from the existing Red Dog Mine; aircraft access to mine sites; a no road alternative; and an alternative that includes increased environmental mitigation measures.

Potential new alternatives concepts were evaluated against the existing screening criteria (see Appendix G), which consist of a 2-step screening process: (1) an initial screening of transportation modes, including road, standard rail, blimp/dirigible, pipeline, elevated rail, narrow-gauge rail, ice road, and barge; and (2) a screening of routes associated with the reasonable transportation modes (see Appendix G, Attachment C for a summary). The BLM considered an alternative's effectiveness at satisfying the purpose and need, its technical and economic feasibility, the practicality of the alternative, and whether the alternative substantially duplicated others already being analyzed in detail. Sections 2.3, Alternatives Considered but Eliminated from Detailed Analysis, and 2.4, Alternatives Retained for Detailed Analysis, describe these alternatives further.

2.3. Alternatives Considered but Eliminated from Detailed Analysis

This section summarizes the BLM's rationale for determining which modes and alternatives are not reasonable. Detailed information can be found in Appendix G, Sections 5 and 6.

2.3.1 Modes and Concepts Eliminated*

The BLM re-examined suggested transportation modes and concepts which were present in the original EIS. The BLM determined the following modes to be not reasonable and thus eliminated them from detailed analysis in this Draft Supplemental EIS.

- **Air (Airplanes/Helicopters).** This mode was discussed in depth by cooperating agencies and focused on whether it could be available as an alternative to support mineral exploration rather than constructing the Phase 1 pioneer road, given that exploration supported by air has currently occurred within the District. The intent of the applicant's purpose and need is to support expanded exploration and development within the District. Air transportation would not adequately support transporting all mining equipment that could be used to conduct exploration and development activities that are expected to occur under a Phase 1 pioneer road. However, given that current mineral exploration is primarily supported by air, since there is no road access to the District, additional information regarding the past, present, and reasonably foreseeable use of aircraft for mineral exploration has been added to the analysis of the No Action Alternative and cumulative effects.
- **Air (Blimp/Dirigible).** The BLM screened out this mode for the reasons given for air (airplanes/helicopters) and because it involves additional speculation and risk related to relying on technology untested for mining support in an Arctic environment.
- **Rail (Elevated Rail).** This mode is speculative because it relies on technology untested in Arctic environments. It would have very high construction costs, essentially building a rail bridge that would be longer than 200 miles.
- **Road (Seasonal Ice Road).** This mode was also discussed by cooperating agencies, including the use of snow trails in conjunction with ice bridge crossings at rivers. This mode would not provide year-round surface access; would be unreliable in the face of a warming climate; and operations and maintenance would not be reasonable or practical, requiring construction of more than 200 miles of new ice road each winter. Given that the applicant proposes to utilize a winter construction access trail (i.e., a snow trail or ice road, with ice bridges) during the first phase of construction of the road, additional information regarding the impacts of winter construction access trails has been added to the actions common to all alternatives analysis in Chapter 3 (Affected Environment and Environmental Consequences) of this Draft Supplemental EIS.

- **Water (Barge/Boat).** This mode was previously determined to not provide year-round surface access. Also, the examined rivers would be too shallow for reliable seasonal access and/or would require dredging.

Pipeline. The BLM previously screened out this mode because pipelines alone would not satisfy the project purpose and need of providing surface access for large mining equipment and heavy loads. These and other alternatives, such as a road and pipeline combination, are further analyzed and screened in Appendix G.

The BLM determined the following concepts to be not reasonable and thus eliminated them from detailed analysis in this Draft Supplemental EIS.

Public Access Road versus Industrial Access Road. Scoping comments for the Supplemental EIS indicated many questions and concerns about public use of the road remain, including the potential for the industrial road to be purposefully opened to the public sometime in the future, much like what occurred with the Dalton Highway. The BLM considered this as part of defining the final alternatives and a cumulative case to carry forward for analysis in this Draft Supplemental EIS.

AIDEA filed an application for a ROW to construct a private industrial access road and associated facilities from the Dalton Highway, crossing multiple land ownerships, including federal public lands managed by the BLM and the NPS, to the District. AIDEA's Standard Form 299 (SF299) ROW application expressly requests ROW for an "industrial-only road," for which access "would be controlled and primarily limited to mining-related industrial uses, although some commercial uses may be allowed under a permit process" (DOWL 2016a; see also Section 2.4.4, Design Features Proposed by AIDEA, Social Systems). Federal statute and regulations provide that BLM and NPS determine the scope of allowable access through the terms and conditions of any ROW authorizations they may issue; AIDEA would have no independent discretion or permit authority if issued a ROW. Additionally, given the isolated conditions, narrow road/bridge design, and large volume of industrial truck traffic, the proposed road would not be safe for general public use. Under Alternative A, B, or C, the road would be planned for industrial access, as well as with use of the road for commercial deliveries unrelated to the District but not general public access. AIDEA has proposed that staffed gatehouses be in place at each end of the road. Appendix H (Indirect and Cumulative Scenarios), Sections 2.2.1 (General Public Access) and 2.2.2 (Commercial Access Scenario), provide further detail about industrial and commercial uses of the road.

ADNR has stated that it must separately adjudicate an easement for state lands and during that process ADNR will address use of the road and restrictions on use. AIDEA has applied to ADNR for an exclusive easement for a private industrial road with potential commercial use for delivery of goods and services, but no public access. Per the State of Alaska, ADNR will address use of the road and restrictions on use when it considers the easement application.

Comments on the Draft EIS received during scoping for the Supplemental EIS questioned the ability of the BLM and AIDEA to keep the Ambler Road private and based such comments on the opening of the Dalton Highway to the general public after nearly 20 years of its northern end being open to industrial traffic only. Members of the public and some cooperating agencies have expressed concern over the potential effects of illegal trespass along the private road on subsistence use and cultural resources and the effects of possible future legal public use on the region. While the road would not be open to the general public by design, public use and trespass are reasonably foreseeable and the impacts of which are therefore analyzed in this Draft Supplemental EIS. Appendix H (Indirect and Cumulative Scenarios) describes reasonably foreseeable access scenarios associated with commercial use, public and non-industrial use, and trespass of the road, and the cumulative and indirect effects of these scenarios are

analyzed in Appendix H (see Section 3) and Chapter 3, Affected Environment and Environmental Consequences, of this Draft Supplemental EIS.

Road without Phasing. A concept for building the road without phasing from seasonal pioneer road (Phase 1) to a year-round 1-lane road (Phase 2) to a 2-lane road (Phase 3) had been mentioned in public comments from scoping and the initial Draft EIS review, was repeated during the recent Supplemental EIS scoping comment period, and was discussed in detail with cooperating agencies in preparing this Draft Supplemental EIS. The potential advantage of building a 2-lane road from the outset is avoidance of the temporary disturbances associated with more than a single construction effort. However, AIDEA's application states that timing of construction of Phases 2 and 3 would be dependent upon the amount of traffic and the need for the additional lane. There is potential that, in a phased project like this, the impacts associated with the later phases may not occur. However, combining the phases that are reasonably foreseeable is a feasible option.

Combining Phases 1, 2, and 3. Phase 3 requires longer culverts than the culverts needed for combined Phases 1 and 2. Therefore culverts would be extended, in addition to additional disturbance associated with widening the road footprint. The footprint for Phase 3, a 2-lane road, would be 60 percent wider than the footprint for Phase 2. Mining operations in the District may never reach the level that the Phase 3 road is needed. Even taking into account that requiring the applicant to commence Phase 3 (forgoing Phases 1 and 2) would reduce the number of construction periods from 3 to 1, the potential reduction in impacts from fewer construction periods would not outweigh the increase in adverse impacts associated with the larger footprint of Phase 3, especially considering that Phase 3 is not anticipated to be necessary in the near term. It is also reasonable to assume that road technology and/or construction techniques for permafrost conditions would only improve between now and the time Phase 3 would be needed. For these reasons, it would not be prudent to proceed directly to construction of a 2-lane road.

The BLM determined that combining Phases 1 and 2 into a single construction phase would be a reasonable option that could apply to any of the action alternatives since a year-round road is necessary to meet project purpose and need (see Section 2.4.8, Combined Phasing Option for All Action Alternatives). However, combining all 3 phases would not be reasonable as it is not known whether the extra lane proposed for Phase 3 would be necessary. Keeping construction of the 2-lane road as a separate phase provides the flexibility to build it only if needed based on future traffic volume.

2.3.2 Alternatives Eliminated*

For this Draft Supplemental EIS, the BLM re-evaluated alternative routes associated with industrial road and overland rail modes—the only modes determined to be reasonable. Roads and rail provide a surface transportation method that is technically feasible and can satisfy the project's purpose and need. These modes rely on proven technology for supporting mining, including in the Arctic environment of the project area. The design criteria for these modes are well understood. The BLM considered narrow-gauge rail but with the caveat that narrow-gauge rail rolling stock could not freely interchange with the standard-gauge rail on the existing Alaska Railroad.

The BLM reconsidered the following road and rail routes and found that the initial results of screening applied during preparation of the original EIS remain valid, resulting in a determination that they are not reasonable.

Volume 4, Map 2-1, depicts these eliminated alternatives. The bullet points that follow provide a brief summary of why alternatives were determined not reasonable. Appendix G provides additional details.

- **Original Brooks East Corridor (Road).** The BLM determined that this alternative substantially duplicates Alternative A and is not reasonable due to greater potential community impacts.
- **Rail to Dalton Highway (Along AIDEA's Proposed Route).** The BLM determined that this alternative is not practical due to substantial material handling inefficiencies at both ends. The BLM determined an isolated rail system, not connected to a port or railroad, to be not practical. It was largely duplicative to the AIDEA-proposed road. With a maintenance road alongside the tracks, it would not have the suggested advantage of discouraging unauthorized users, and it would have similar impacts and no construction or operational cost advantage.
- **Kanuti Flats Corridor (Road).** Of the environmental factors measured during screening, this alternative crossed more anadromous fish streams and affected more riparian acreage compared with other alternatives. It would have similar community concerns as the Original Brooks East Corridor. The BLM found it substantially similar to Alternatives A and B.
- **Parks Highway Railroad Corridor (Railroad Connecting to the Alaska Railroad).** Because of its length, this alternative would have among the highest costs and environmental impacts. This alternative would also have technical and practicality issues.
- **Elliott Highway Corridor (Road).** This is the longest road route examined and would require a large bridge over the Yukon River. It is also the most expensive road route examined. This route would be substantially duplicative of Alternative C.
- **DMTS Port Corridor (Road or Rail).** Capacity limitations at the Delong Mountain Transportation System (DMTS) Port mean that this alternative would require building a new port. Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs and potential environmental impacts.
- **Road to Kiana/Barge (Kobuk River).** The BLM eliminated this alternative because the Kobuk River is too shallow; therefore, barging ore and supplies on this route would not be feasible.
- **Cape Blossom Corridor (Road or Rail).** Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs and potential environmental impacts.
- **Selawik Flats Corridor (Road or Rail).** This alternative was discussed in detail with cooperating agencies, given the large number of scoping comments requesting a western route, and the potential viability of a logical end point at the Port of Nome, where a deep water port is now considered reasonably foreseeable given funding for planning and construction of the port. The BLM rescreened this alternative in detail, reapplying each of the route screening criteria. Ultimately, the alternative was eliminated from further analysis in the Draft Supplemental EIS due to environmental impacts, especially to subsistence resources; its high cost; and practicality concerns. This alternative has one of the highest levels of impacts to caribou habitat (affecting almost twice as much caribou habitat as the applicant's proposed route) and involves the greatest number of known anadromous fish stream crossings of any of the alternatives. The BLM considered the following additional information in applying the practicality screening criteria (i.e., Does the alternative have unacceptable environmental impacts relative to other alternatives?):
  - A large portion of the route is located on lands with the highest percentage of fall migration use by the WAH.
  - The route crosses four major anadromous rivers—the Kobuk, Selawik, Buckland, and Koyuk.

    - The route could indirectly result in impacts to marine mammals, including threatened and endangered species.

The BLM also considered alignment variations on the Selawik Flats route suggested during scoping and found them not reasonable for similar reasons.

- **Cape Darby Corridor (Road or Rail).** Because it would not connect to a usable port, it does not have a rational end point for the project and therefore does not satisfy the project's purpose and need. The BLM also considered high costs, and environmental and practicality considerations. The BLM considered alignment variations on the Cape Darby route suggested during scoping and found them not reasonable for similar reasons.

During public scoping for the Supplemental EIS, the BLM received a request from TCC for the BLM to consider a Tribal Alternative that would maximize protection for subsistence and cultural resources by modifying the route and incorporating other design features. However, the alternative did not specify a route (meaning, a description or depiction of the course to be taken from a starting point to an ending point). Because the Tribal Alternative did not describe a route, it could not be properly screened to determine whether it is technically or economically feasible, or whether it meets the stated purpose and need. Appendix G contains a detailed discussion about the Tribal Alternative.

2.4. Alternatives Retained for Detailed Analysis

2.4.1 Screening Results: Alternatives Retained*

After review and based on reconsideration of the screening analysis, the BLM determined that the following alternatives remain reasonable and retained them for detailed analysis in the Draft Supplemental EIS. Volume 4, Map 2-2 depicts these retained alternatives.

- **Alternative A: AIDEA Proposed Route (Gates of the Arctic National Park and Preserve North [GARR North]) to the Dalton Highway.** This alternative is the applicant's proposed route. Screening data indicated this alternative would be constructible and less expensive than other alternatives. This alternative would have a logical terminus (rational end point) connecting into the road and rail network to provide year-round access to existing port facilities located to the south.
- **Alternative B: AIDEA Proposed Alternative Route (Gates of the Arctic National Park and Preserve South [GAAR South]) to the Dalton Highway.** This alternative shares much of its length with Alternative A, and screening data indicated it is substantially similar to that route. Despite the similarities, the BLM retained it because it provides a distinct route across GAAR and is consistent with the alternatives the NPS is evaluating in its Environmental and Economic Analysis. Furthermore, although this alternative is identical to Alternative A in those areas where it crosses BLM-managed lands, it merits treatment as a separate alternative in this EIS because the U.S. Army Corps of Engineers (USACE) is a cooperating agency and the route is not identical across areas falling under USACE's jurisdiction.
- **Alternative C: Diagonal Route to the Dalton Highway.** The BLM developed this alternative based on scoping comments in 2018. The 332-mile route would entail more new construction than the other reasonable alternatives but has a similar driving length from the District to Fairbanks. This alternative would have a logical terminus (rational end point) connecting into the road and rail network to provide year-round access to existing port facilities. Public comments during scoping for the original EIS showed some public support for this alignment and the potential to benefit communities along its route. The BLM carried this alternative forward for detailed analysis after considering all screening criteria, including meeting the project's purpose

and need and environmental factors. No comments on Alternative C were received during the scoping period for the Supplemental EIS.

In addition to the three alternative routes retained for detailed analysis described above, the BLM is also analyzing the following phasing option, which could be applied to any of these 3 alternatives. This phasing option would build the initial phase of the road to the Phase 2 standards as described under Section 2.4.3, Features Common to All Action Alternatives, Construction Phasing, and would not build a Phase 1 version of the road. It would still include Phase 3 of the road as described under Section 2.4.3. Additional details on this option are provided below.

- **Combining Phasing Option for All Action Alternatives.** The BLM developed this option based on public comments, new information, and cooperating agency input. This option would eliminate Phase 1 and would initially build the entire road to Phase 2 standards. This option was developed to address impacts on permafrost, water quality, and fish and to reduce noise and disturbance impacts from staging and operating construction equipment for 2 separate phases. It is estimated that construction of the route to Phase 2 requirements would require a single mobilization of construction equipment and construction time of approximately 2 to 3 years (compared to 3 to 4 years for separate construction of Phase 1 and Phase 2 roads). Further details about construction are provided in Appendix G, Sections 6.4.2.

2.4.2 No Action Alternative

Under the No Action Alternative, the BLM would not grant land use authorizations, and no road would be constructed or operated to the District. A No Action Alternative is required to be included in a National Environmental Policy Act analysis. The No Action Alternative provides a baseline against which action alternative impacts can be compared.

2.4.3 Features Common to All Action Alternatives*

This section discusses the design and operational features attributable to the action alternatives. The BLM was informed by AIDEA that all aspects of their original application remain valid and that there are no substantive changes to the route, construction techniques, ancillary facilities, or other features as described in the 2016 application and 2019 amended application. Sections 2.4.5, Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway, through 2.4.7, Alternative C: Diagonal Route to the Dalton Highway, discuss specific routing and important distinctions associated with each action alternative. Volume 4, Map 2-2, illustrates locations of some of the features discussed below.

Proposed Road. The road under all action alternatives ultimately would be a 2-lane, 32-foot-wide, all-season gravel road. Supporting infrastructure would include bridges, culverts, road maintenance stations every 50 to 75 miles, vehicle turnouts, material sites, water source access roads, and airstrips. Appendix A, Figures, Figure 2-1 shows a typical cross section of the proposed road.

Access. Under any of the action alternatives, road access would be intended for industrial traffic transporting large, heavy equipment; ore; and goods and supplies in support of mine exploration, development, and operations. AIDEA has also requested that commercial access (for deliveries of goods to local communities and residents) and access for emergency response be allowed The road would not be open to the general public by design, but public use and trespass are expected and will be analyzed. Appendix H describes anticipated traffic (Table 2-5) and use of the road (Section 2.2).

Vehicles. The primary vehicles to use the road during operation would be trucks hauling mineral exploration and development equipment and ore concentrate, as well as supplies (including fuel). AIDEA is proposing a semi-trailer truck (WB-62 design) with 22,000-pound per standard axle loading and a

street-legal maximum width of 8 feet, 6 inches as the design vehicle (i.e., the vehicle to which roadway design specifications are targeted). Other vehicles and equipment anticipated to use the road include pickup trucks, road graders and plows, and fuel delivery trucks. All trucks hauling ore concentrates would be covered and sealed to prevent the release of ore concentrate, and trucks hauling 2 trailers of ore concentrate (66 short wet tons) is the assumed typical configuration. Appendix A, Figure 2-2 depicts a typical truck and container system.

Road Traffic Volumes. In its application, AIDEA indicated that total traffic, including fuel and other supplies, would be up to 80 trucks per day (40 round trips) during production (DOWL 2016a). Based on Appendix H, and extrapolated to include other mines, the project annual average daily traffic during peak years could be 168 trips per day, year-round, when other mines are in production. Double-trailer ore loads on the Ambler Road would be split and become single-trailer loads for transport on the Dalton Highway and other public roads. Appendix H describes anticipated traffic and use of the road.

Right-of-Way. AIDEA has requested a ROW with a 50-year term. The requested ROW would be 250 feet wide in most areas, although at bridge crossings and steep terrain, the width may need to be up to 400 feet to accommodate cut and fill slopes. The project with all of its ancillary facilities could be authorized with a number of different types of land use authorizations including rights-of-way, communication leases, permits, and contracts for the sale of mineral materials.. AIDEA would have legal and financial responsibility for managing road construction and road maintenance and operations within the authorized project; however, it is assumed AIDEA would procure road design, construction, maintenance, and operation services through other parties. See Volume 4, Maps 2-3 and 2-4, for the location of proposed maintenance stations and material sites.

Construction Phasing. AIDEA has proposed building the project in 3 phases (Phases 1 through 3, described below). Road construction likely would begin in support of mining exploration and would not be dependent on mine development permits or approvals. The BLM is also considering a combined phasing option for the alternatives that would require the project be constructed in 2 phases only (see Section 2.4.8, Combined Phasing Option for All Action Alternatives). The following descriptions of construction phases apply to all of the action alternatives, with the exception that under the combined phasing option, construction of a pioneer road under Phase 1 would not occur and the road would be constructed to Phase 2 standards from the start.

Phase 1: Phase 1 would construct a single-lane, gravel-surfaced pioneer road, typically 16 feet wide (including 2-foot-wide shoulders) on a shallow roadbed. The Phase 1 pioneer road would be constructed over 2 years. A winter construction access trail (i.e., a snow trail or ice road, with ice bridges) would be established during the first year, and the pioneer road would be completed in the second year. Construction of the pioneer road would likely require year-round activity. This phase would result in a road that would be used August to April, with restricted access during spring and early summer to minimize roadway damage. Phase 1 would transition directly to Phase 2. All proposed bridges would be constructed as 1-lane bridges (23 feet wide) in Phase 1 and would remain as 1-lane bridges through all construction and operational phases. The majority of bridge construction activities would take place in winter when rivers were frozen, facilitating temporary river crossings during construction. Culverts placed in Phase 1 would be the length needed for Phase 2.

Phase 2: Phase 2 would reconstruct the pioneer road to be a 1-lane, gravel-surfaced roadway, typically 20 feet wide, over a full-depth embankment (roadbed). Construction of Phase 2 is anticipated to take 2 years to complete. This phase would result in year-round access but would likely be operated in only a single direction at a time, with guided convoys of trucks traveling in 1 direction during certain hours and then in the other direction at other times.

Phase 3: Phase 3 would be constructed once traffic volumes justified upgrading the road, anticipated to be approximately 10 years after construction of Phase 2. Phase 3 would expand the road to 32 feet wide (2 full lanes) by widening the then-existing Phase 2 footprint[3] and extending the culverts. The Phase 3 road would be an all-season gravel road with a design speed (i.e., the speed that roadway geometry would accommodate) of 50 miles per hour. It is anticipated that sections would be posted for lower speeds and actual operating speeds would likely be lower (particularly in Phases 1 and 2). Expansion of the Phase 2 road to Phase 3 is anticipated to take 2 years to complete.

Construction Camps. AIDEA has proposed construction camps to facilitate construction. AIDEA has estimated each camp to be 5 acres, with room for a helipad, equipment and material storage, and employee facilities (e.g., housing, food service). Construction would occur in both directions from these camp areas (which would be spaced approximately every 40 to 45 miles), with equipment staged along the road corridor. See Volume 4, Maps 2-3 and 2-4, for the location of proposed construction camps.

Construction Staging Areas. AIDEA has proposed that material sites would be used to provide temporary staging areas for construction activities, although some separate staging areas would be needed. Staging areas typically would be less than 1 acre and located within the footprint when required outside of material sites. Additional temporary staging and construction areas would likely be required for bridges, but would be within the proposed footprint.

Operations. It is anticipated that AIDEA would procure services of other parties to maintain and operate the road using fees levied on mining companies. Proposed operations include controlling access, maintaining security around the clock (including staffed gates at each end of the road and regular patrols), and responding to emergencies. Access at the staffed gates would be denied to the general public, including area residents. However, federal statute and regulations provide that BLM and NPS determine the scope of allowable access through the terms and conditions of any ROW authorizations they may issue; AIDEA would have no independent discretion or permit authority if issued a ROW. The road would not be open to the general public by design, but public use and trespass are expected to occur. Commercial access (for deliveries of goods to local communities and residents) and access for emergency response would also occur.

Access protocols for the road would be similar to those for the North Slope oil fields at Deadhorse, where the Dalton Highway (existing, maintained public highway) terminates, but permitted industrial users may continue on the industrial road network. AIDEA has proposed that staffed gates would be located at each end of the Ambler Road and at other locations, if needed (Davis 2019). At the east-end guardhouse, there would be space for an office, bathroom, small kitchen, and emergency bunking accommodations. Personnel would be housed at the nearby maintenance station. AIDEA would establish an authorization and training process, and anyone accessing the road (drivers or passengers) would be required to take specialized safety training, have a very high frequency (VHF) radio, and carry personal protective equipment. Only authorized and commercially licensed drivers would be allowed to drive the road. AIDEA has proposed to adopt the wildlife interaction protocols used on its Red Dog Mine road (DMTS) during operation of the proposed Ambler Road, which would include vehicles waiting when caribou are nearby.

[3] Footprints used to calculate impacts in Chapter 3 (Affected Environment and Environmental Consequences) include areas of cuts and fills for the project elements plus a 10-foot buffer around those limits for construction access, clearing, and other temporary effects. A 10-foot buffer is a common buffer applied to road projects in Alaska. It represents an area of sufficient width for construction equipment to operate. The buffer is not typically used along the entire alignment; therefore, it represents a conservative estimate of the potential impacts. The impacts to the construction area are generally considered temporary.

All drivers would be required to have 2-way radios and to report their positions regularly, likely hourly. No commercial fueling stations would be established. Permanent road maintenance stations would have fuel for maintenance equipment. The road operator would be required to have personnel trained in first aid and emergency spill response at each maintenance station. All maintenance and security vehicles and staffed facilities would be required to have spill response equipment.

During Phases 1 and 2, when the road is a single lane, most use is anticipated to be in a single direction at a time and may include convoys of trucks moving in a single direction. In Phase 3, when the road is widened to 2 lanes, bridges would still be 1 lane wide. Radio communication would coordinate traffic. Mining companies are anticipated to need areas at each end of the road to stage convoys. At the eastern end, this is assumed to be the maintenance station/material site located in that area, but could include a new area established under mining company authorizations (i.e., separate from this road authorization). The western end would similarly make use of a maintenance station or material site, or would be addressed through mining company proposals and authorizations.

Maintenance. AIDEA proposes that the road for all action alternatives would receive regular maintenance, including grading, sanding, and snow plowing. The maintenance schedule would depend on the amount of traffic. As traffic grows, more wear and tear would occur, and maintenance would need to occur more often. AIDEA estimates that 2 inches of gravel would be needed annually to maintain the roadway (see Appendix C, Table 1 for gravel estimates (in cubic yards) during construction and maintenance) and that dust control chemicals (palliatives) such as calcium chloride would be applied to reduce dust emissions.

Fuel and Chemicals – Road Construction, Maintenance, and Operations. Small spills or drips at fueling locations would be handled with standard best management practices (BMPs). Spills due to a crash or other accident along the road would be contained as quickly as possible using response equipment maintained on every operations and maintenance vehicle. Fuel would be stored in double-wall tanks meant to serve as secondary containment to reduce spills. Fuel storage facilities would include spill detection equipment. Tanks would be regularly inspected. BMPs would be employed for storage and handling of chemicals for dust control, deicing, cleaning, vehicle maintenance, and other purposes.

Material Sites and Maintenance Facilities. AIDEA has proposed to develop material sites to obtain gravel and riprap for construction and maintenance. Some of the material sites would be expected to be developed into long-term roadway maintenance facilities. These long-term sites would house maintenance workers and include landing strips. Most material sites would require access roads of varying lengths to connect the borrow location to the proposed road. Additionally, side roads would be constructed to provide access to water sources for road construction and maintenance activities. Appendix A, Figure 2-3, illustrates a typical maintenance station facility. See Volume 4, Maps 2-3 and 2-4, for the location of proposed maintenance stations and material sites.

Airstrips. Long-term road maintenance stations would each have an airstrip approximately 150 feet wide and 3,000 feet long. These are spaced approximately every 70 miles. During construction phases, at least weekly flights (1 to 2 per week) are likely to each airstrip to change out construction crews. Likewise, during road operations, it is likely there would be 1 to 2 flights weekly to each airstrip/maintenance station to change road maintenance and security crews. During construction of Phases 2 and 3, when the road would be operating and also under construction, these 2 to 4 flights per week could occur to account for both operation/maintenance and construction crew changes. Most flights likely would be by 9- to 12-passenger aircraft (e.g., Cessna 208 Caravan). During construction, additional flights are likely to occur by helicopter to construction camps and specific sites such as bridges. During road operations, in particular, some crew changes might occur by van rather than by aircraft. These airstrips would be closed

and potentially reclaimed at the end the road's useful life, along with all project components. See Volume 4, Maps 2-3 and 2-4, for the location of proposed airstrips.

Communications. Communications along the road would include a VHF 2-way radio system for security of traffic on the road, a fiber optic line tied to the VHF radio system to enhance the radio system and provide an internet connection to long-term maintenance stations, and a backup satellite system. The fiber optic line would be within a 1.25-inch conduit and would be laid within the road embankment (i.e., there would be no separate trench in native soils); directional drilling would be used to feed the line under larger drainages. Some material sites and the maintenance stations would be sites for communications equipment, including radio towers approximately 100 to 150 feet tall and satellite dishes approximately 10 feet tall. A small heated building at each site would house communications electronics. A generator and 4,000-gallon diesel fuel tank would be located at communications facilities at material sites. At long-term road maintenance stations, the communications system would be tied to the generator and fuel source for the entire site. Communications sites would be located every 30 to 40 miles, and each would be sited within the footprint of a material site or maintenance station. The radio towers and satellite equipment would be installed during Phase 1 and the fiber optic line during Phase 2 (or all would be installed in Phase 2 under the combined phasing option). Appendix A, Figure 2-4 illustrates proposed communications facilities.

Funding and Costs. AIDEA is a State of Alaska corporation given separate corporate identity by statute (Alaska Statute [AS] 44.88). AIDEA has its own authority to issue bonds, enter into contracts, and own land rights without involvement or legal obligation of the State of Alaska. AIDEA's funds are separate from the State of Alaska General Fund. AIDEA indicates that no state General Fund dollars and no federal funds would be used for construction. AIDEA plans to issue revenue bonds as a principal tool to finance the construction of the project. These taxable bonds would be sold through private placements to various potential buyers (e.g., banks, investment funds, high-net-worth individuals, and others). In the event that the project is not successful, the investors or bondholders who purchased bonds to finance the project assume the risk of the project's revenues falling short. AIDEA has separate bonding authority and a separate bond rating from the State of Alaska. Bonds issued by AIDEA do not become a liability of the State and, therefore, would not affect the State's bond rating. The bonds would be repaid by assessing annual fees on the users of the road through a lease agreement. AIDEA has stated at Draft EIS public meetings and indicates on its website that the project would not move ahead with road construction until legal agreements were in hand with the mining companies that would use the road. Funding for maintenance and operations and ongoing mitigation costs would be a pass-through charge to the mining companies using the road. Construction costs for the full build-out of each alternative (Phase 3) are listed in Appendix C, Chapter 2 Alternatives Tables and Supplemental Information, Table 1. The first phase of construction would be the highest expenditure because it would clear the way for other phases and all bridges would be installed in Phase 1. The subsequent phase(s) would be expansions of the road embankment and would cost less.

Project Lifespan, Closure, and Reclamation. The lifespan of the proposed road would be dependent upon the success of exploration and extraction efforts within the District. In its application, AIDEA proposes to reclaim the road and anticipates that would occur at the end of the 50-year project, or when mineral exploration and development activities in the District conclude (an extension of the authorization would require a new review and decision by the BLM and other authorizing agencies). Appendix H contains a hypothetical timeline of road, mine, and reclamation activities. AIDEA has not yet submitted t a detailed closure and reclamation plan for road project facilities. This would be separate from any mining closure and mine reclamation plans. AIDEA would be responsible for road reclamation. In general, AIDEA proposes to remove all equipment and buildings (including foundations); remove all culverts and bridges and re-establish natural channels (removing bridge abutments, cutting off driven bridge piles

below streambeds); and re-grade the embankments and pads where necessary to approximate natural contours, and avoid erosion and seed bare areas. Airstrip and maintenance station building pads (fill) would be removed and re-contoured to pre-construction grades. Where not used in re-contouring, AIDEA has proposed that material from pads and the road would be disposed of in former material extraction sites. Any material containing naturally occurring asbestos (NOA) used in the embankments would be removed and capped with non-asbestos material. AIDEA anticipates that all reclamation work would occur within the developed footprint of the road project. Removed items would be re-used when possible (e.g., modular buildings), recycled when economically feasible, and otherwise disposed of in existing permitted landfills outside the road corridor. The land would revert to the full control and management of the underlying landowner. Monitoring would occur to ensure reclamation goals, such as erosion control, were met. AIDEA indicates the entire road would be closed and reclaimed in a single effort, with no segments remaining temporarily open, and that insurance for the project would require 100 percent removal to ensure no lingering uninsured liability. However, mining companies may request, from the underlying landowner(s), that some segments of the road within the District stay open and revert to mining company control to allow their continued access from the Dahl Creek airport or mining company airstrips to the mines for required water treatment and monitoring activities, to be conducted potentially in perpetuity. These requests would require separate environmental approval when and if the requests were made. As noted below, the certainty of this reclamation is subject to various unknown project features.

Climate Change-related Challenges. The existing and ongoing effects of climate change may present challenges for all of the action alternatives in terms of project design and operations and could potentially affect the practicability and technical feasibility of the action alternatives over time. For example, changing climate conditions could negatively affect the reliability and practicability of a winter construction access trail, which is common to all features of the action alternatives.

Uncertain Project Features. There are several uncertainties associated with all three Action Alternatives. Without on-the-ground surveys, the layout, staging, and sequencing of construction actions are not fully known, and impacts are approximate. Unknown ground conditions such as depth of permafrost or presence of clay/silt lenses underlying the area are not verified and could cause construability issues (e.g., settlement). With respect to bridges, foundation requirements, hydraulics, and ice flow designs are unknown; although using typical square-foot costs with contingencies can cover many situations, if ground or river conditions don't follow forecasted path, there could be a greater need for engineering solutions and more frequent maintenance. Permafrost is a very unstable and challenging environment that presents constructability and decommissioning issues. Thawing of permafrost alters drainage patterns and causes thermokarst features in unpredictable ways that are difficult to account for in this analysis. Material site sources are untested and locations unknown, therefore the availability of appropriate types, quality, and volumes of mineral materials is unknown. Poor quality materials would require greater maintenance and lead to greater sediment runoff. Soil conditions underlying the roadbed are unknown and the volume of mineral materials needed for construction and ongoing maintenance could exceed current estimates. Limited specifications regarding road engineering design and associated mine development also present unknowns which limit the certainty of any analysis. And, finally, there is uncertainty regarding the process of reclamation of the road and any associated harm. All of these uncertainties have the potential to affect project costs, feasibility, and impacts from the road.

2.4.4 Design Features Proposed by AIDEA*

The following design features have been proposed by AIDEA as a means of minimizing or mitigating for potential impacts and remain valid for this Draft Supplemental EIS. The design features would apply to each action alternative and would be implemented across the entire length of each alternative, regardless of land ownership.

General Responsibilities and Plan of Development

- AIDEA would submit to the BLM, separately or as part of the plan of development (POD), a financing plan that indicated surety of the funding needed to build and operate the road according to the POD. Indication of AIDEA's financial ability to fund the project and its removal would be via binding agreements with mining companies, project investors, or other funders, indication of the ability to issue sufficient revenue bonds, and indication of acceptable financial instruments to ensure road closure and reclamation. The financing plan would be submitted for review and approval before the BLM would issue a Notice to Proceed to begin construction of any portion of the Ambler Road.

General Completion of Use (Restoration/Reclamation)

- AIDEA would prepare and submit for approval a detailed closure and reclamation plan that would include (1) a plan for closure and reclamation of 100 percent of the road project, including the road's full length, and including removal of all related buildings, airstrips, material sites, bridges and their abutments and piers, culverts, and communications equipment; (2) a timing and sequencing plan that shows reclamation as a single effort for the entire road (even if undertaken over 2 or more seasons); (3) a plan to dispose of all demolition scrap and debris outside the road corridor; (4) a plan for disposal of embankment material not needed for restoring natural contours, including safe disposal and capping of any materials that contain NOA and cleanup and disposal of any contaminated soils; (5) an update to the project's invasive species management plan; (6) an update to the project's stormwater pollution prevention plan, including detail regarding restoration of stream channels to approximately natural courses with minimal harm to aquatic life; and (7) a post-reclamation monitoring plan (e.g., for erosion, invasive plant species, use of the corridor for access).

> AIDEA's application states that, at the project's outset, before final approval for construction, AIDEA would pre-fund a Reclamation Reserve Fund or similar bonding instrument to the satisfaction of the BLM and other landowners providing authorizations for the road, to provide for adequate reclamation during the closure and reclamation period. However, as noted above, there is uncertainty about this, given that the financing throughout the life of the project hinges on sufficient revenue from mining companies and is therefore vulnerable to the investment decisions of those entities.

Operations

- AIDEA would ensure personnel with current training in first aid were always present at construction and maintenance camps.

Physical Environment

- Geotechnical field studies and detailed thermal modeling would be completed, and specific measures to be incorporated in specific areas would be identified during final design after the alignment has received approval from the appropriate federal and state agencies to control permafrost thawing.
- Cut slopes exposing ice-rich permafrost are particularly susceptible to erosion and would be stabilized using a mat of riprap or porous, granular material placed on a geotextile fabric. The porous rock material and geotextile fabric would be used to cover the exposed ice-rich soils and would extend to the toe of the embankment slope, allowing water to flow through the subsurface soils beneath the roadway embankment.
- Embankment thicknesses would be increased where permafrost is likely and cut sections would be avoided to the greatest extent practical to minimize permafrost exposure. Since permafrost

degradation typically begins at the toe of the fill slope and spreads under the embankment, fill slopes should be ideally as flat as possible (constructing benched berms alongside the embankment is a common approach). During Phases 1 and 2, fill slopes at culverts would be flattened to provide sufficient burial cover over the culverts to protect the pipes. The flatter fill slopes and more gradual transition from the roadway embankment to existing ground would also help reduce permafrost degradation at the stream crossings. Flattening the fill slopes would be weighed against the increased footprint of the roadway.

- Provisions for reducing permafrost degradation would be included in project design. Potential methods for addressing permafrost concerns include embankment insulation, air convention embankment, thermosyphons, sunsheds, snowsheds, or air ducts. For example, 6 inches of rigid insulation board could be installed under culvert bedding material for increased insulation..
- Snow would be plowed off the road shoulders and embankment slopes to facilitate dissipation of heat out of the roadway embankment and reduce the likelihood of permafrost degradation. The operations and maintenance BMPs covering snow plowing would be incorporated into the stipulations of the authorizations and carried through into AIDEA's contract requirements for any road operator hired by AIDEA.
- Additional soil stability and erosion measures, such as riprap armoring and installation of erosion control matting, would be incorporated in the design where conditions suggest erosion may be an issue. Geotextile fabric would be placed beneath the riprap as appropriate to prevent migration of fines out of the underlying soils into surface water flows.
- AIDEA would avoid the use of materials containing NOA to the greatest extent feasible. For the purposes of this project, AIDEA has identified a threshold of 0.1 percent asbestos by mass as its definition of NOA materials (DOT&PF's regulations are specified for materials above 0.25 percent NOA; however, AIDEA has committed to a lower threshold). If use of NOA materials cannot be avoided, AIDEA would follow DOT&PF measures as allowed under 17 Alaska Administrative Code 97 and described in their May 14, 2015, regulations regarding the use of materials containing NOA.
- Sufficient oil-spill-cleanup materials (e.g., absorbents, containment devices) would be carried by field crews on all project maintenance and security vehicles.
- Project design features that mitigate impacts to permafrost and hydrology would be incorporated based on geologic and hydrologic studies to freely convey surface water across the road surface and minimize impacts on groundwater flows. As additional studies are completed during future design phases to identify areas with high risk of permafrost degradation, additional design measures would be incorporated. See also Section 3.2.1, Geology and Soils, for further information about permafrost soils.
- The planned construction of the road would use fill techniques with minimal cutting of native soils to the maximum extent practical. Cut areas would be examined further during future design phases to evaluate the risk of intercepting groundwater flows. High-risk areas would be mitigated by adjusting the roadway profile to reduce or eliminate the required cut or by incorporating appropriate drainage measures to collect and convey the exposed water.
- Bridges and culverts would be installed at all identified drainage crossings, including rills and ephemeral channels, to maintain hydrologic connectivity, minimize changes to watershed basin areas, and reduce the likelihood of water impoundment degrading permafrost. An adequate number of culverts and/or bridges would be installed to maintain hydrologic continuity and existing drainage patterns within wetland complexes, ephemeral channels, and perennial stream

channels. AIDEA would evaluate the use of bridges versus culverts on braided streams to reduce impacts to the stream and allow natural stream channel movement.

- The collection of upstream runoff in ditches would be minimized to reduce the effects of diverting surface waters to adjacent drainage ways, maintain existing flow patterns and quantities, and reduce the potential for permafrost degradation. Roadside ditches would only be used in limited cut areas where permafrost presence is unlikely. The elevated (fill) aspect of the road is expected to avoid impacts to shallow groundwater sources; if there are site-specific concerns about damming shallow groundwater or wetting of the embankment, coarse materials would be placed at the lowest levels of the embankment to facilitate groundwater movement across the system (see also Section 3.2.1, Geology and Soils).
- Culverts and bridges would be sized to adequately span (at a minimum) the bankfull width of the natural channel to minimize changes to stream flow velocities during base and flood flows and to maintain natural channel functions, such as sediment/debris transport and wildlife passage. Stream banks would be stabilized at road crossings to minimize the potential for erosion and downstream sedimentation.
- All culverts determined by resource agencies as necessary to maintain hydrologic connectivity during full build-out of the project (Phase 3 would be installed during the first phase of construction). Length of culverts installed during Phase 1 would be as needed for Phase 2.
- An adaptive management plan for monitoring, maintaining, and repairing culverts over the life of the road would be developed, with ADF&G and USACE input. The plan would include documentation of culvert locations using a global positioning system, and regular monitoring during culvert installation and through road operations. The plan would identify corrective measures that would be taken if concerns are identified, and timeframes for those measures to be implemented. Corrective measures may include additional culverts, increasing culvert sizes, adding thaw lines, adding dead-man anchors, or other appropriate measures. The proposed subsistence advisory committee (see design feature under Social Systems) would help in the oversight of the plan and overall road operations and maintenance.
- Design techniques would be employed during design phases to facilitate shallow groundwater flow beneath the road embankment. Installation of multiple culverts in parallel, at a subsurface layer of porous, rocky substrate, and subsurface drains/pipe are potential options.
- Riprap would be placed around the culvert ends at all phases of construction to protect and stabilize the slope of the embankment, reducing erosion of embankment material and minimizing the risk of embankment failure at the crossing during flood events. AIDEA would minimize the use of erosion controls that use plastic and use 100 percent biodegradable materials to the greatest extent practicable. Plastic materials used in sensitive areas would be removed once areas are stabilized. Geo-cells may be considered for stabilization on steep slopes.
- Design and construction of large bridges would employ measures to minimize effects on water flow and fish migration. Specific design features related to this mitigation would be determined during the design/permitting phase, and would include measures such as:
    - Use of clean temporary diversion structures (e.g., Super Sack containers).
    - Working in low-water conditions when the need for diversion and dewatering requirements are lessened.
    - Minimizing use of riprap by exploring bioengineering alternatives for bank protection and stabilization.
    - Placing pilings to allow for unimpeded river traffic.

    - Restricting in-water construction during critical migration and spawning movements.

- A stormwater pollution prevention plan would be developed for construction and would identify BMPs to be implemented to reduce the potential for water quality impacts. BMPs also would be incorporated for road operation and maintenance activities to minimize potential impacts on water quality. Measures would include barriers to capture and filter stormwater at construction area boundaries, stabilization of disturbed areas as quickly as feasible, designation of specific areas for fueling, practices for drilling and driving piling and disposing of any drilling mud, and maintaining equipment to reduce the potential for unintentional releases. The operating and maintenance BMPs would be incorporated into the stipulations of the authorizations and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.
- Trucks hauling concentrate from the District to the Dalton Highway would be required to use covered, sealed containers to prevent ore concentrate from escaping the haul trucks and minimize the potential for impacts on streams from concentrate transport. The operating requirement would be incorporated into the stipulations of the authorizations and carried through into AIDEA's permit requirements of any road user.
- A spill prevention and response plan would be developed to guide construction and operation activities. The plan would identify measures to reduce the potential for fuel spills, locations of spill response materials, and training of construction and maintenance staff on spill response. AIDEA would also develop a concentrate recovery plan similar to that developed at the Red Dog Mine to address concentrate spills. Details of the plans would be incorporated into the stipulations of the authorizations and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.
- All bridges would be designed to adequately convey at a minimum the 100-year peak flood without damage to the roadway embankment or adjacent channel reaches. Scour characteristics of rivers at bridge crossings would be evaluated to minimize long-term risk to bridge abutments and piers. Culverts would be designed to convey at a minimum the 50- or 100-year peak flood depending on site characteristics and perceived risk, as determined on a case-by-case basis. All stream simulation and other moderate to major culverts would be designed to convey the 100-year peak flood, at a minimum.
- During design, culvert widths and bridge spans would be increased as needed, and/or overflow culverts would be installed to improve floodplain connectivity and accommodate stream characteristics to reduce the likelihood of damming or erosion. Overflow culverts, typically set at higher elevations relative to the primary culvert, would be considered at stream crossings where aufeis formation is probable. The overflow culverts would greatly improve the ability to keep water flowing across the roadway and prevent erosion and damming should flow through the primary culvert become impeded or blocked by ice. Overflow culverts also would be considered at stream crossings where there is a high likelihood of large woody debris (e.g., fallen trees) blocking culverts, based on the prevalence of timbered banks and active stream erosion upstream of the crossing. Overflow culverts also would be considered at broad, active floodplains, especially where the main stream channel is poorly defined, to better accommodate hydrologic connectivity across the floodplain.
- During construction, AIDEA has proposed requiring contractors to use the following techniques to reduce construction noise:
    - Place stationary noise sources away from noise-sensitive locations.
    - Turn idling equipment off.

  - Drive equipment forward instead of backward, lift instead of drag materials, and avoid scraping or banging activities.
  - Use quieter equipment with properly sized and maintained mufflers, engine intake silencers, less obtrusive backup alarms (e.g., manually adjustable, self-adjusting, or broadband sound alarms instead of traditional "beep-beep-beep" alarms), engine enclosures, or noise blankets.
  - Purchase and use new equipment rather than using older equipment. New equipment tends to be quieter than older equipment due to new technology, improvements in mechanical efficiency, improved casing and enclosures, and other innovations.
- Dust palliatives would be applied to the gravel road to reduce the potential for dust. The University of Alaska Fairbanks (UAF) Alaska University Transportation Center has been studying dust palliatives for several years, and this project would incorporate the latest technologies for dust minimization and mitigation based on UAF studies. Details of the plans would be incorporated into the stipulations of the authorizations and carried through into AIDEA's contract requirements of any road operator hired by AIDEA.
- Construction emissions would be minimized through use of standard BMPs related to dust suppression, equipment maintenance, and other factors.

Biological Resources

- Fish surveys would be undertaken to assess whether fish are present in the rivers and streams in the action area at various freshwater life history stages. The scope of the fish surveys would be coordinated with ADF&G, USFWS, and National Marine Fisheries Service if and when a corridor has been approved. Results from the fish surveys would be shared with ADF&G for nomination and potential inclusion in the Anadromous Waters Catalog.
- Stabilization and restoration of sites disturbed during construction activities would occur in a timely manner within the post-disturbance growing season as work is completed. Disturbed soils would be stabilized and revegetated with native plant materials to reduce visual impacts and the potential for soil erosion and sediment discharge. AIDEA would work with the Alaska Plant Materials Center and the relevant land manager to develop a plan for obtaining native plant seed and/or cuttings to be used for restoration and reclamation needs.
- Reclamation of the industrial access road and support facilities would be undertaken at the end of the 50-year project. A detailed reclamation plan containing sufficient performance standards subject to land manager approval would be developed prior to the issuance of the authorizations. Reclamation measures would include removal of embankments, culverts, and bridges; re-grading the roadway to establish more natural ground contours and drainage patterns; and revegetation of the area through seeding or planting of native vegetation. Appropriate native plant materials would be identified in consultation with the Alaska Plant Materials Center and each landowner. Since reclamation methods are likely to improve between now and the end of the road's useful life, it should be anticipated that an updated detailed reclamation plan would be developed closer to road closure.
- In areas where the proposed roadway footprint requires the fill of wetlands and does not contain a defined channel, minor culverts (less than 3-foot diameter) would be installed at approximately 150-foot spacing to maintain hydrologic connectivity between bisected wetlands. Culvert spacing and sizing would ultimately be determined during permitting based on additional design information.

- Measures to avoid wetland loss would include design efforts to minimize impacts to wetlands and streams such as traversing upland habitats with less than 10 percent longitudinal grades; avoiding sloughs, ponds, and lakes, typically by a minimum of 50 feet; locating river crossings at straight sections; avoiding braided or multiple channels; and crossing rivers at the narrowest point feasible. Other design minimization measures would include shifting the alignment to impact lower-value wetlands and following existing roads or trails where possible.
- If selected, AIDEA would evaluate whether the Alternative A corridor can be shifted any further north to increase the distance from the Nutuvukti Fen. AIDEA would collect additional soils and hydrology information along the road alignment in the fen area and evaluate additional measures to further minimize effects on the fen. AIDEA would evaluate the potential to use porous fill materials in this area to allow more groundwater to flow through the road embankment.
- For waterways to be crossed with culverts and which are deemed to be fish-bearing, the design would comply with ADF&G fish passage standards, which require prescribed velocities and capacities among other design factors, to minimize and/or mitigate impacts to fish habitat from construction activities and operations. Design features of each fish stream crossing structure would be determined through coordination with the ADF&G during the design/permitting phase and incorporated into permit stipulations to ensure structures are designed to maintain fish passage per the Fish Passage Act (AS 16.05.841).
- All perennial rivers and streams are assumed to provide fish habitat, and crossings of them would be designed to provide fish passage. Crossings of well-established ephemeral channels likely to provide fish habitat during seasonal flow periods would also be designed to provide fish passage. Fish passage culverts would be designed and installed using stream simulation principles with embedded culverts filled with substrate to replicate natural channel characteristics and function. Fish passage crossings would be designed to convey the 100-year peak flood (1 percent exceedance probability). See Section 2.5.7 (Water Resources), Water – General, for additional culvert information. The design, construction, and installation of all anadromous water crossings would comply with the methods and recommendations in "Culvert Design Guidelines for Ecological Function, Alaska Fish Passage Program" (USFWS 2020). All fish passage culvert designs would additionally comply with the State of Washington stream simulation culvert width standards, which call for culvert widths of 1.2 times bankfull width plus 2 feet.
- AIDEA would comply with ADF&G permit requirements for all in-water work in salmon streams, including timing restrictions.
- Construction of the road would comply with possible restrictions during bird nesting periods in accordance with the Migratory Bird Treaty Act.
- AIDEA would incorporate the abatement and wildlife interaction protocols used on the Delong Mountain Transportation System into construction and operation of the Ambler Road. Details of the operating plan would be carried through into AIDEA's permit requirements of any road user.
- AIDEA communications protocol for road users would include coordination and notification to drivers of currently observed animal patterns, including migration patterns, to increase awareness of potential animal and vehicle conflicts. AIDEA would develop communication protocols in conjunction with wildlife managers. The communication protocols would be carried through into AIDEA's permit requirements of any road user.
- AIDEA would adopt a caribou policy that AIDEA and all contractors and road users would make every effort to ensure caribou are not disturbed in their efforts to cross the road. The operating policy would prevent the free-flow of traffic on the Ambler Road whenever caribou are crossing or are in the area. During times of caribou herd seasonal migration, the policy would allow for the

closure of the road for several consecutive days. During such herd movements, AIDEA would monitor caribou movement and maintain a log of herd movement based on location and numbers of animals. Records would be maintained and shared annually with ADF&G and the Authorized Officer.

Social Systems

- AIDEA proposes to operate the Ambler Road as an industrial access road not open to the general public and to establish a road-use access system to ensure allowed uses only, as determined by BLM and NPS through the terms and conditions of any ROW authorizations they may issue. AIDEA proposes to maintain a staffed gate at the Dalton Highway end of the road to strictly regulate access. A similar gate would be established near the western end, near the boundary of the District. By design, the road would not be open to general public use for any purpose or by any means, including vehicles, on foot, or by bicycle, except for crossing the road at designated and safe locations. The BLM's interpretation of AIDEA's proposal is: (1) drivers on official mining business to and from the District; (2) road construction and road maintenance personnel on official business; (3) the road's fiber optics and satellite communications system installation and maintenance personnel on official business; (4) road construction and maintenance camp employees on official business; (5) borough, state, and federal land management agency personnel or Native regional corporation landowners' land management or permitting personnel on official business for lands adjacent to the road or within the District; (6) regulatory agency personnel on official business associated with compliance, monitoring, inspection, or enforcement for the Ambler Road project or District authorizations; (7) state and federal emergency response officials or crews (police, medical, fire) on official business; and (8) commercial companies/drivers transporting goods or fuel for communities near the road, including for private landowners whose parcels may not be directly adjoining or associated with a named community (outlying Native allotments and similar private properties). None of these classes of road users would be allowed to transport members of the general public as passengers, whether for a fee or not, except those passengers on official business as stated above.
- Bridges would be designed to minimize impacts on river flow and allow continued navigation on the river by watercraft that use each particular river, typically rafts, canoes, kayaks, and small motorized vessels. Where commercial/industrial barges are possible, the bridges would be designed for passage of tugs and barges.
- Kobuk River bridge design would consider aesthetics and incorporate design measures that minimize visual impacts. This includes incorporating brush and willows into riprap areas or using geo-cells for stabilization on steep slopes to reduce riprap and promote vegetation establishment.
- Revegetation of fill slopes with native seed, trees, and/or shrubs on topsoil could be used as a mitigation technique to reduce the contrast between the gravel road and the existing forest. Design features related to this mitigation would be determined during the design/permitting phase and would be incorporated into authorization stipulations.
- AIDEA would form a subsistence working group for communication and knowledge sharing. The group would help determine where subsistence users would need to cross the road. The number and extent of these crossings would be negotiated with the group. Ramps would be constructed in select areas to aid such crossings if the subsistence working group determines that such construction is warranted to mitigate impacts to subsistence.

2.4.5 Alternative A: AIDEA Proposed Route (GAAR North) to the Dalton Highway

Alternative A is a 211-mile alignment (25 miles traverse BLM-managed land), accessing the District from the east, with its eastern terminus at Milepost (MP) 161 of the Dalton Highway. It runs almost directly

west to the District across primarily State-managed, BLM-managed, and GAAR lands. The corridor traverses the south side of the Brooks Range, following a series of stream and river valleys oriented roughly east-west, separating the Schwatka Mountains from a series of smaller mountain ranges and foothills, including the Ninemile Hills, Jack White Range, Alatna Hills, Helpmejack Hills, Akoliakruich Hills, Angayucham Mountains, and Cosmos Hills. This route crosses GAAR farther north than Alternative B (see Volume 4, Map 2-3).

2.4.6 Alternative B: AIDEA Alternative Route (GAAR South) to the Dalton Highway

Alternative B is a 228-mile alignment (25 miles traverse BLM-managed land), with its eastern terminus at MP 161 of the Dalton Highway. It follows the same alignment as Alternative A except it loops to the south to pass through GAAR at a location that crosses less National Preserve land and is farther from the Park and Wilderness boundary (see Volume 4, Map 2-3).

2.4.7 Alternative C: Diagonal Route to the Dalton Highway

Alternative C is a 332-mile alignment (274 miles traverse BLM-managed land), with its eastern terminus at MP 59.5 of the Dalton Highway. It approaches the District from the southeast, primarily across BLM-managed lands. From the Dalton Highway, the route crosses the Ray River and traverses the Ray Mountains, then roughly heads northwest toward Hughes before passing through the Indian Mountains, and then follows the Koyukuk River south. Just north of Hughes, the route continues northwest, crossing the Hogatza River, traversing the Pah Valley, passing the Selawik National Wildlife Refuge, and proceeding north past Kobuk to join the Alternative A/B alignment near the common terminus at the south bank of the Ambler River (see Volume 4, Map 2-4).

2.4.8 Combined Phasing Option for All Action Alternatives*

In addition to the three alternative routes retained for detailed analysis described above, the BLM is also analyzing the following phasing option, which could be applied to any of these 3 alternatives. The combined phasing option applies to all of the action alternatives (Alternatives A, B, and C) and would require construction to occur in two phases only. Phases 1 and 2 would be combined into a single phase, whereby the road would be initially constructed to Phase 2 standards (year-round 1-lane road) from the start, without the construction of a pioneer road. It is estimated that construction of the route to Phase 2 requirements would require a single mobilization of construction equipment and construction time of approximately 2 to 3 years (compared to 3 to 4 years for separate construction of Phase 1 and Phase 2 roads).

2.4.9 Summary of Major Project Components for Each Action Alternative*

The action alternatives have similar infrastructure features and would operate similarly. However, each alternative has a different length and traverses different terrain, and therefore each has different numbers of components and features. Appendix C, Table 1 summarizes major project components for each action alternative.

Appendix C (Chapter 2 Alternatives Tables and Supplemental Information) includes a summary of impacts for each Alternative, both in narrative form (Section 1.5 of Appendix C) and a table format (Table 2 of Appendix C).

3. Affected Environment and Environmental Consequences*

3.1. Introduction*

Chapter 3 describes the affected environment (baseline conditions), environmental consequences of the alternatives described in Chapter 2 (Alternatives), and potential mitigation.

Project Area. The project area or "affected environment" is generally defined as the area from the Brooks Range (same latitude as the northern edge of the Ambler Mining District) south to the Yukon River and from the Dalton Highway corridor west to Kobuk Valley National Park (Volume 4, Map 1-1). The study area (also sometimes called the "scope of analysis"[4]) encompasses the area where direct, indirect, and cumulative impacts would be anticipated. The study area, however, may differ for each resource—from narrow areas limited to the proposed road corridors to more expansive areas defined by the movement of caribou, fish, or subsistence hunters. The sections in this chapter address these individual resource study areas if they are unique and the maps in Volume 4 depict the geographic extent.

Impacts Defined. CEQ regulations require that EISs address direct, indirect (secondary), and cumulative impacts. This chapter summarizes these impacts. Direct effects are those that occur at the time and place of the proposed project. Indirect effects are those that may occur farther from the project or later in time but are reasonably foreseeable to result from the proposed project. Cumulative effects are those from the project combined with past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions. See Appendix H, for additional details on mining and other reasonably foreseeable development impacts.

In accordance with ANILCA , and Congress's direction that "the Secretary **shall permit** [emphasis added] such access [i.e., surface transportation to access the Ambler Mining District to the Alaska Pipeline Haul Road]," through the GAAR (but not BLM lands) AIDEA has proposed a road for access to the District, with the assumption that providing access would lead to mining exploration and development. This Draft Supplemental EIS is not in response to a mining proposal; therefore, the BLM has analyzed the road based on the currently known characteristics of the region and provides analysis of the potential impacts from future mining. Consequently, in this Draft Supplemental EIS, direct impacts are those that occur at the time and place of road construction and operation (attributable to the road's footprint and anticipated use of the road). The BLM considers mining exploration and mine development to be reasonably foreseeable if the road were to be built. Therefore, this analysis treats impacts resulting from mining exploration and development expected to occur off the road and later in time as indirect and cumulative effects.

The proposed action (Alternative A) is a 211-mile road that would cross land owned or managed by multiple parties, including the BLM. Under any alternative, the BLM manages only a portion of the corridor, and the BLM's purpose statement (see Section 1.4, Purpose and Need for Federal Action) is associated with the portions that would occur on BLM-managed lands. The USACE jurisdiction extends to waters of the United States along the full length of any alternative. The USACE purpose statement (see

[4] "Scope of analysis" is defined as the part of the project; its alternatives; and the direct, indirect, and cumulative impacts the USACE would consider in evaluating a permit application. In general, it is the USACE's position that the geographic extent of this review authority and the level of analysis would vary with the amount of federal control and responsibility over a project and the strength of the relationship between those impacts and the regulated portion of the activity (see nctc.fws.gov/courses/csp/csp3112/resources/index.html).

Section 1.4, Purpose and Need for Federal Action) is associated with these waters wherever they occur along any alternative as land status is immaterial to the scope of the USACE's jurisdiction. For this reason, certain impacts are indirect effects of the BLM's proposed federal action (granting authorizations across BLM-managed lands) but are direct effects of the USACE's proposed federal action (issuing a permit for fill in WOTUS). For purposes of this effects analysis, however, the distinction between an indirect and direct effect is ultimately immaterial because NEPA requires analysis of both types of effects. Therefore, the effects analysis in this chapter generally does not distinguish between the type of action or effect, but addresses all effects for all actions.

Reasonably Foreseeable Actions. AIDEA has provided some detail regarding the proposed road, but similar details were not provided for mining proposals. To evaluate the indirect and cumulative effects of reasonably foreseeable development, the BLM obtained input from a variety of stakeholders, including government and private sector mining professionals, AIDEA, companies that anticipate mining in the District, and the public (through scoping) to develop a reasonably foreseeable development scenario (see Appendix H). This scenario presents a forecast of mining development and activity anticipated to result in road use during the 50-year life of the project and other reasonably foreseeable actions, and discloses the anticipated indirect and cumulative effects of that development and activity.

The BLM also considered the impacts of road construction and use of the road for mining access in regard to climate change. Biological and physical resources are anticipated to be affected by climate change under all alternatives, and specific impacts are discussed in the following sections for each resource as appropriate. Additional discussion is included in Appendix H.

The BLM and cooperating agencies re-examined reasonably foreseeable actions from the previous 2020 Final EIS and made updates, as necessary, to incorporate new and updated information (see Appendix H).

Project Phasing. AIDEA has proposed building the road in 3 phases starting with a pioneer road in Phase 1, then constructing a 1-lane gravel road in Phase 2, then expanding to a 2-lane gravel road in Phase 3. The impact analysis focuses on the most impactful phase (i.e., the phase with the greatest potential for significant impacts). For most resource topics, Phase 3 would have the largest footprint and most traffic, and would be anticipated to operate for the largest number of years over the 50-year life of the project. This analysis identifies impacts that could be significant in Phases 1 and 2 that are different from those anticipated in Phase 3. This analysis also identifies how impacts would differ between the combined phasing option (i.e., 2 phases only) for all action alternatives and the 3 phase alternatives. The intent of the combined phasing option is to avoid and minimize impacts on permafrost, water quality, and fish and to reduce noise and disturbance impacts from staging and operating construction equipment for 2 separate phases.

Severity of Impacts. In evaluating impacts of road construction and use of the road for mining access, the BLM considered the duration of activities associated with each as well as the magnitude of the impact. Appendix H describes the development schedule with respect to the road construction (to occur in 2 to 3 phases) and operations (use of the road for mining access over a 50-year period). The analyses presented in this chapter address impacts for the activities based on the duration of the impact, often referring to temporary impacts associated with construction and long-term or permanent impacts related to the long-term presence of a road in the project area, including effects beyond the life of the project. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. These analyses quantify the magnitude of the impact to the extent possible, typically in tables in Appendices C (Chapter 2 Alternatives Tables and Supplemental Information), D (Chapter 3 Physical Environment Tables and Supplemental Information), E (Chapter 3 Biological Resources Tables and Supplemental Information), and F (Chapter 3 Social Systems Tables and Supplemental Information) or express it qualitatively relative

to the No Action Alternative. The analyses also address the likelihood of any given impact occurring, often as definitive ("would" occur) or potential ("could" or "may" occur). The maps in Volume 4 of this Supplemental EIS also help to illustrate likelihood of impact by showing the proximity of resources to the alternatives. The location and extent of impacts typically is described, and often is depicted on these maps. A summary of the severity of impacts, expressed as the likelihood, magnitude, duration, and extent of impact, appears in Appendix C, Section 1.5 (Summary of Impacts), along with a more complete definition of terms.

Data Limitations. Based on a review of the data that are available, summarized, and cited in this document and accompanying appendices, sufficient data exist to allow the BLM to make a reasoned choice among the alternatives and ensure potentially significant impacts are disclosed before such a decision is made. According to 40 CFR 1502.22, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS and there is incomplete or unavailable information, the agency would make clear that such information is lacking. The BLM evaluated the data to determine if any missing information would be relevant to reasonably foreseeable significant adverse impacts; whether it would be essential to a reasoned choice among alternatives; and if it were, whether the overall costs of obtaining it would not be exorbitant. Where information was relevant and essential and the costs were not exorbitant, that information was collected (e.g., wetland delineation, updated engineering for Alternative C, economic analysis, etc.). As required by 40 CFR 1502.22, this Supplemental EIS makes clear to the reader where information is lacking, explains the relevance of the information, and summarizes the existing credible scientific evidence that does exist and is relevant to evaluating reasonably foreseeable significant adverse impacts on the human environment. The BLM has evaluated the impacts in the EIS based upon research methods and theoretical approaches that are accepted in the scientific community.

In preparing this Supplemental EIS, the BLM and cooperating agencies re-examined each resource analysis from the original EIS to identify areas where new data and information was available for incorporation into the Supplemental EIS, with a focus on identifying new data and information related to deficiencies identified during the litigation process.

Measures to Reduce Impacts. This Supplemental EIS also discusses potential measures to reduce impacts, and it presents detailed measures in Appendix N that may be selected to minimize or mitigate impacts. Appendix N presents a list of potential measures the BLM and regulatory agencies with jurisdiction could require as part of their authorizations for the Ambler Road project. It contains measures that have arisen from law, regulation, and plan policy; AIDEA or other agencies have proposed; or have arisen as the BLM has worked through the analysis in the EIS. The following analyses assume design features committed to by AIDEA in Chapter 2 (Section 2.4.4, Design Features Proposed by AIDEA) would be implemented. The potential mitigation measures included in Appendix N are presented for consideration by BLM and other federal agencies. This list is intended to be applicable to the range of activities AIDEA has proposed; however, not every measure listed would be applicable to every activity/authorization. The BLM may authorize portions of the project under separate authorizations, such as a ROW for the road ROW and ancillary facilities, permits for short term activities and separate authorizations for material extraction and sales.

Only a portion of each alternative would be on BLM-managed land, and therefore the BLM's authority to require and enforce specific mitigation measures may be limited. No decision would be made until the ROD, including decisions on which mitigation measures would apply. Each agency or landowner may select measures such as these for inclusion in decisions related to their own jurisdictions. Because no specific mining proposal is under consideration, no specific mitigation is proposed for the indirect mining scenario. Such mitigation would be applied for each of those mines as they go through the environmental

approval process. Standard mitigations for contemporary mines are generally known and have been assumed to be applied to mines evaluated in Appendix H. For a recent example of typical mitigation required for a mine in Alaska, see the Donlin Gold Mine EIS (USACE 2018).

In preparing this Supplemental EIS, the BLM and cooperating agencies re-evaluated potential mitigation measures from the original Final EIS to determine if new or modified mitigation measures were warranted.

3.2. Physical Environment*

3.2.1 Geology and Soils*

Affected Environment

Overview

Geology. The project area spans multiple physiographic provinces (i.e., geographic regions with characteristic geomorphology; Warhaftig 1965). Alternatives A and B follow the southern foothills of the Brooks Range and run through the Arctic Mountains province (DOWL 2011a), which consists of glacier-carved mountains and hills of folded and faulted sedimentary rocks and their metamorphic equivalents. Alluvium and glacial drift fill the valleys and lowlands between ranges. Continuous permafrost underlies this region. The north end of Alternative C runs through the Arctic Mountains province, as well as the Northern Plateau and Western Alaska provinces. The Northern Plateau province is comprised of rolling hills covered with eolian deposits and V-shaped valleys filled with alluvial deposits. The Western Alaska province is characterized by features varying from rolling hills to lowlands dotted with thaw lakes and cut by meandering streams. Discontinuous permafrost occurs along Alternative C. The main geologic terranes (i.e., fault-bounded regions with distinctive structure and geological history) include the Ruby, Angayucham, and the Koyukuk terranes (Colpern and Nelson 2011). Appendix D, Table 1, presents an overview of project area geologic units.

Soils. Soil types in the project area vary widely, but have common characteristics: they all developed under a cold temperature regime in which biological and chemical transformations are slow and soil horizons or layers are subject to physical dislocations as a result of freeze-thaw processes (BLM 2016a). Project-specific terrain unit mapping present along the western half of Alternatives A and B identified silty-ice-rich deposits and noted the presence of organic deposits, pingos, thaw lakes, and "swampy areas" (DOWL 2011a). Mapped areas near Hughes in Alternative C include terrace gravel, alluvium, possible outwash, lacustrine deposits, muskegs, glacial lake deposits, loess, ice-rich silts, and glacial till. BLM's *Central Yukon Resource Management Plan, Analysis of Management Situation*, summarizes soil resources and their current conditions in the Central Yukon area (see BLM 2016a: Section 2.1.2, Soil Resources) and is incorporated here by reference.

Geology and Soils Hazards

Geological hazards are natural conditions that could alter the landscape or damage structures and injure humans. Potential geologic hazards present in the project area include fault rupture and related seismic hazards (e.g., ground motion, liquefaction, lateral spreading); sudden slope movement (e.g., landslides, rockslides, rockfall, snow avalanches); slower slope movement (e.g., creep in permafrost, frozen debris lobes, rock glaciers, frost action/solifluction); distress due to permafrost degradation or warming (e.g., thaw settlement, retrogressive thaw slumps, thermokarsts); settlement due to loading of compressible soils (e.g., peat, clay); and impacts from water or ice (e.g., flooding, aufeis). Exposure of subsurface iron sulfide minerals to air and water could result in the creation and leaching of acidic drainage into water bodies, which could cause adverse impacts on aquatic organisms and habitat. Geologic and soil hazards

identified in the area include seismicity, permafrost, naturally occurring asbestos (NOA), metal leaching, and acid rock drainage (ARD).

Seismic. Alaska is among the most seismically active regions in the world. The Kobuk fault follows the southern edge of the Brooks Range, south of Alternatives A and B. The Kaltag fault runs east-west, south of Alternative C (Warhaftig 1965). The seismic hazard maps for Alaska show that Western Interior Alaska has less probability of high ground motion than the Southcentral Alaska coastal area and Aleutian chain (Wesson et al. 1999).

Permafrost. Permafrost is subsurface soil that has remained at temperatures below 32 degrees Fahrenheit (°F) for at least 2 consecutive years. Where present, permafrost slows drainage, which, combined with low soil temperatures, has resulted in soil with wet, shallow, poorly differentiated profiles and substantial, minimally decomposed organic matter. Detailed permafrost mapping of the project is not available, and regional mapping relied on decades old data (Jorgenson 2008).[5] The regional mapping shows that Alternatives A and B traverse primarily mountainous areas of continuous permafrost (greater than 90 percent), with some sections of discontinuous permafrost (50 to 90 percent) along lowlands near the John and Koyukuk river crossings (Jorgenson et al. 2008). Alternative C crosses a continuous permafrost area at its north and south ends, a discontinuous permafrost area in the mountainous area at the south end, and mostly discontinuous permafrost areas through the lowlands and river crossings (Jorgenson et al. 2008). However, the NPS has identified discontinuous permafrost occurring throughout the project area that crosses GAAR (NPS 2019a), and comments from Trilogy Metals (now Ambler Metals LLC) on this Supplemental EIS identified that their exploratory work showed discontinuous permafrost throughout the southern Brooks Range near Alternatives A and B.

The Mean Annual Air Temperature (MAAT) indicates that these permafrost soils can be considered warm (greater than 30°F) as compared to cold permafrost soils on the Arctic Slope. These soils are highly susceptible to erosion or other soil movements caused by disturbances to ground-covering vegetation and subsequent thawing of the permafrost. Depending on soil type and ice content, permafrost may be considered thaw-stable, where foundation materials are unchanged in unfrozen condition, or thaw-sensitive (unstable), where the foundation experiences loss of strength and thaw settlement upon thawing. Aerial imagery and limited geotechnical investigations indicate the presence of ice-rich, thaw-sensitive permafrost along parts of each route. Volume 4, Map 3-1, indicates related areas of likely continuous and discontinuous permafrost; continuous permafrost is likely to be more stable.

Asbestos. Asbestos is a term used to describe a class of minerals that form long, thin, very strong fibers. Asbestos fibers do not dissolve in water or evaporate, and are resistant to heat, fire, and chemical or biological degradation. Because of these qualities, asbestos was mined and used in making thousands of products (e.g., insulation, fireproofing materials, brake linings, roofing shingles, etc.). Mining of asbestos for products has ended in the United States; however, many products and older buildings still contain these materials.

Disturbing natural or commercial asbestos-containing materials can release tiny fibers, too small to see, into the air. Workers, and others who breathe asbestos fibers over many years can develop asbestos-related diseases, including asbestosis, lung cancer, and mesothelioma. Some of these diseases can be serious or fatal (ATSDR 2019). People may be exposed to asbestos from swallowing fibers or getting

[5] The BLM determined that the presence of permafrost would occur among all alternatives. Geotechnical investigations proposed during the design phase would identify their presence, extent, and stability, and the road would be designed and constructed to avoid and minimize impacts using appropriate and standard road design practices.

them on their skin; however, the effects are less serious. Most regulations focus on breathing (inhalation) exposures when evaluating health effects of exposure.

NOA is found in mineral deposits in many parts of Alaska, as well as many other states. Previous surveys have found NOA in mineral deposits in rock and soils in the project area. A preliminary evaluation of bedrock potential for NOA in the project area shows all action alternatives traverse areas of medium potential for NOA and cross large swaths of surficial deposits that are unevaluated for NOA potential (Solie and Athey 2015; see Volume 4, Map 3-2). The Alaska Department of Transportation and Public Facilities (DOT&PF) conducted explorations for suitable material sites in 2004 and 2013 for the Ambler Airport improvements project. Most test sites within surficial deposit areas had measurable concentrations of NOA present. Studies have also identified NOA in the Ambler Mineral Belt near the confluence of the Kobuk and Shungnak rivers (DOWL 2011a). DOT&PF (2009) issued a study on available information regarding NOA in Alaska and established guidance for the usage of materials with NOA.

Natural weathering and human activities, including road construction, may disturb asbestos-bearing rock or soil and release mineral fibers into the air. This creates potential for human exposure by inhalation. Asbestos fibers may remain in the lungs for a lifetime without causing health-related issues, but in some cases, asbestos fibers can damage the lungs and cause asbestos-related disease (NewFields 2019). These diseases commonly do not appear for 20 or more years after the start of exposure (NewFields 2019).

Most studies regarding asbestos risk involve occupational settings, where workers are exposed to high levels of asbestos in an indoor setting. It is more difficult to identify risks related to exposure to NOA that is intermittent, uncontrolled, and outdoors. Due to the prevalence of NOA in many locations in the Alaska environment, there is the possibility that some undetermined risk for asbestos exposure is present from background concentrations of airborne NOA.

Due to the toxicity and health dangers posed by asbestos (ATSDR 2019), there are laws and regulations implemented by EPA and other federal agencies to protect the public from asbestos exposure (EPA 2020). These include banning the manufacturing, import, processing, and distribution of some asbestos-containing products and establishing worker protection rules and regulations. The Occupational Safety and Health Administration (OSHA) and Mining Safety and Health Administration (MSHA) have established protections for workers in construction and mining where asbestos is present. The OSHA/MHSA Permissible Exposure Limit is 0.1 fiber per cubic centimeter (f/cc) of air over an 8-hour time-weighted average, with an Excursion Limit of 1.0 asbestos f/cc over a 30-minute period. Depending on their breathing rate, workers could legally be exposed to several hundred thousand to more than a million asbestos fibers in a typical 8-hour shift. Employers must ensure, through monitoring, operating procedures, engineering controls, respiratory protection, and training, that their workers are not exposed above these limits. The EPA established an asbestos airborne clearance level of 0.01 f/cc for worksites within schools.

The State of Alaska enacted a law and guidance with respect to the use of gravel materials containing NOA for construction projects. While the law was designed to release material site owners and state agencies from liability associated with construction projects, AIDEA proposes to follow DOT&PF guidance to demonstrate its commitment to minimizing asbestos impacts. The guidance requires creating comprehensive plans for sampling and analysis, dust control, operations and maintenance (O&M), and compliance. Under the State guidance, gravel roads, airstrips, or other exposed surfaces need to be paved or covered by non-NOA-containing materials. Under AS 44.42.430(2), the state defines NOA-containing materials as those "determined to have a content equal to or greater than 0.25 percent naturally occurring asbestos by mass." Non-NOA-containing materials does not mean that the materials have no asbestos fibers present, nor does it correlate with the OSHA and MSHA limits. Due to the many different factors that affect how much asbestos becomes airborne as part of road dust, the concentration of NOA in

materials cannot be correlated with possible airborne exposure related to OSHA, MSHA, or EPA limits. The 0.25 percent level matches the State of California's allowable concentration for use in unpaved road surfaces, and was developed based on existing sampling and testing protocols.

AIDEA has committed (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) to follow DOT&PF guidance for road construction based on material with NOA at no more than 0.1 percent mass or greater. This is stricter than the state definition of 0.25 (60 percent lower) and is meant to result in lower risk of asbestos exposure.

Metal Leaching and Acid Rock Drainage. Metal leaching and acid rock drainage (ARD) are naturally occurring processes that are caused when minerals containing metals and sulfides come in contact with air and water. The oxidization of iron sulfides in the presence of water, air, and/or bacteria results in acids carried by water drainages, known as ARD. The outflow of acidic water from this process would have an adverse effect on vegetation, soil organisms, water quality, and aquatic life. The acids in ARD can leach metals such as iron, lead, silver, and copper from surrounding rocks. The oxidized metals commonly create yellow, orange, and red colors in the bedrock; aerial imagery identified areas exhibiting this characteristic staining in multiple locations along all action alternatives, indicating the potential for ARD (DOWL 2011a). Volcanogenic massive sulfide (VMS) deposits have been identified previously in the Ambler Mineral Belt and along the southern Brooks Range (DOWL 2011a). Should VMS deposits be identified during geotechnical investigations, depending on the concentrations of sulfide minerals in the deposits and neutralizing capacity of the surrounding rocks, they may indicate the potential for ARD conditions to develop.

Metals and metalloids such as selenium, zinc, and arsenic can also be leached from reactions in non-acidic conditions, including neutral pH ranges.

Minerals

The proposed project provides access to the District, which has been explored for mineral potential since the 1950s and contains a major mineral belt (Grybeck et al. 1996). Nova Copper U.S. Inc. (now Trilogy Metals, Inc. or Ambler Metals LLC[6]), Valhalla Mining LLC, and Teck Alaska Incorporated have staked more than 160,000 acres of mining claims in the District. The project may provide access to existing claims or mineral occurrences along the selected transportation corridor, including the following:

- Mining claim clusters along the routes include those near the Zane Hills and the Ray Mountains along Alternative C.
- Mining districts, claims, mines, and mineral occurrences and prospects along the project alternatives (see Section 3.4.1, Land Ownership, Use, Management, and Special Designations).
- Rare earth elements (REEs), placer gold, platinum group elements (PGEs), carbonate-hosted copper, sandstone-hosted uranium, and tin-tungsten-molybdenum deposits (see maps in Appendix H).
- Bituminous coal occurrences along Alternatives A and B in the Upper Koyukuk Basin (total estimated resource quantity unknown) and sub-bituminous coal occurrences along Alternative C in the Rampart Field (estimated resources: 50 million short tons; see BLM 2018b).

The following sources provide additional information and are incorporated by reference: (1) the 2015 Ambler Mining Region Economic Impact Analysis (see Chapter 7 in Cardno 2015) provides estimated

[6] In February 2020, Trilogy Metals Inc. and South32 Limited announced the completion of the formation of a 50/50 joint venture company named Ambler Metals LLC (Ambler Metals). Ambler Metals will be working to advance the Upper Kobuk Mineral Projects, including the Arctic and Bornite Projects.

economic impact on the region, including from potential mineral resources; and (2) the Alaska Resource Data File (ARDF) is a compilation of documented mineral prospects, occurrences, and mines (USGS n.d.). Appendix H provides a summary of mining potential and describes anticipated mining development the BLM predicts is reasonably foreseeable.

Environmental Consequences

Road Impacts

The road and its associated facilities would transect areas with existing geological hazards as well as unfavorable soil and subsurface conditions, which road construction and use may exacerbate. These include corrosive subsurface minerals; liquefiable soils; and organic-rich, ice-rich, poorly drained, or thaw-sensitive permafrost soils. Geotechnical investigations conducted during the design phase would identify these issues, and the road would be designed and constructed to avoid and minimize their risks using appropriate and standard road design practices. Soil and geological hazards may be addressed by modifying alignments, choosing appropriate cut and fill geometry, implementing slope and/or embankment stabilization measures, using wider and thicker embankments on thaw-sensitive permafrost to reduce thaw settlement, and developing road embankment and bridge designs to resist seismic hazards.

The project provides access to the District. Additionally, the road may provide access to potential mineral areas along the selected route. For most mineral occurrences in remote locations, access is a crucial part of determining feasibility for further development. Appendix H further describes potential impacts associated with mining.

No Action Alternative Impacts

Under the No Action Alternative, there would be no change or impact to geology and topography. Climate temperature trends and permafrost temperatures over the past decades show a defined increase. Increasing permafrost temperatures may lead to increased creep rates of soils on slopes and slope failures. Permafrost warming and thawing may lead to development of thaw settlement and thaw ponds. There would be no change to the existing placement of acid-bearing rocks or minerals containing NOA, and therefore no additional changes to the affected environment. Mineral exploration activities would be anticipated to develop more slowly in the District, and large-scale development and extraction projects would be less likely to occur. Continuation of mining development and ore exploration would likely generate similar air traffic levels as today, with similar potential impacts to soil and permafrost resources as exist today.

Impacts Common to All Action Alternatives

There would be localized changes to the geology and topography for any action alternative. Road construction in fill areas would add load from material and traffic to the current soils and subsurface structure. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. A potential impact includes road embankment settlement due to loading of compressible soils (e.g., peat, clay). Section 3.2.5, Water Resources, discusses changes to drainage and water resources by the placement of the road through the project area.

All action alternatives are exposed to the geological hazards described under Affected Environment, although the route lengths exposed to the different geological hazards vary. Seismicity along each of the action alternative alignments is relatively low.

Permafrost Impacts. All action alternatives are underlain by discontinuous or continuous permafrost. Volume 4, Map 3-1, and Appendix D, Table 2, present areas of permafrost in relation to the alternatives.

As permafrost thaws, ice in the permafrost melts and can cause the soil above to sink, resulting in ground subsidence (settlement) and damage to roads, buildings, and other infrastructure (EPA 2017). The ice-rich soils in the proposed corridors would warm and potentially thaw with or without construction within the time frame of the proposed Ambler Road project life span. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. However, with construction, the site-specific area soils are anticipated to experience amplified or accelerated thawing, resulting in increased material demands and maintenance costs from uneven settlement (EPA 2017).

Road construction would change drainage and vegetation patterns, remove the insulating vegetation layer, and change topography by constructing fill or cut sections along the alignment, disturbing the existing natural thermal regime. Potential impacts due to road construction include distress due to permafrost degradation or warming (e.g., thaw settlement, retrogressive thaw slumps, thermokarsts, soil creep). The use of seasonal ice roads and trails during construction would impact permafrost in varying ways depending on the type of vegetation, disturbance type, and depth of the active layer; however, the depth of permafrost thaw increases each year following ice road construction (Yokel and Ver Hoef 2014).Changed drainage patterns would result in increased sedimentation (erosion and deposition) as permafrost soils thaw. Road performance deficiencies resulting from thermal instability may include shoulder rotation, frost heaving, excess moisture in the road section, pot-holing, ponding, surface and shoulder erosion, heaving, subsidence, and rutting. Additional gravel resources would be required for roadway maintenance and repair.

Changes to the natural thermal regime cannot be avoided; however, impacts would be minimized by using appropriate fill material and embankment designs and construction approaches. The gravel roadway embankment is proposed to be 3 to 8 feet thick to provide additional insulation to underlying soils. However, gravel material absorbs more solar radiation than natural vegetation and could lead to increased permafrost thaw, especially on the south face of east-west roadway alignments. Phased construction may accelerate subsurface soil temperature increases, as Phase 1 pioneer road construction would not include all design measures to insulate the roadway. Drainage changes occurring during Phase 1 (pioneer road) and Phase 2 (1-lane road) could impound water, warming subsurface soils along areas to be encompassed by the Phase 3 (2-lane) footprint. Should permafrost thaw issues occur during Phases 1 or 2, when the road width is narrower, shoulder rotations and embankment cracks could also impact the drivable surface. A combined phasing option has potential to reduce the impacts to soil and permafrost resources by limiting the duration of construction activities to a single phase of construction over fewer years, thereby requiring less temporary construction staging and access, and by eliminating the pioneer road and constructing a thicker permafrost protective embankment.

The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Dust kicked up by vehicle traffic on a road (called fugitive dust emissions) would settle on snow, foliage, or bare ground, likely affecting an area approximately 328 feet (100 meters) from the roadway edge (Walker and Everett 1987; Auerbach et al. 1997; Myers-Smith et al. 2006; McGanahan et al. 2017). The spread of road dust may result in more rapid melting of snow and additional warming of soils beyond the road footprint. AIDEA proposed potential design features to avoid and minimize permafrost thaw and impacts from permafrost thaw (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Such measures are likely to be mostly, but not completely, successful where implemented and maintained. Some permafrost may melt regardless and could result in impacts as described above, including impacts to the road that may require repair. Where the road would cross lands managed by others, it is likely similar design measures would be required.

Unauthorized road users are discussed in Section 3.4.2, Transportation and Access; unauthorized users are not anticipated to have significant impacts on the geology and soil resources but could result in unsafe operational conditions and contribute to localized impacts due to off-road travel in thaw-sensitive areas.

Soil warming and thawing permafrost would make previously frozen, stable soils vulnerable to decomposition that generates GHGs such as carbon dioxide (CO_2) and methane (CH_4). The release of these GHGs from soils across polar regions is anticipated to create a feedback loop that would amplify or accelerate climate warming beyond existing projections (Anthony et al. 2018). The magnitude and timing of these emissions are uncertain (Schuur et al. 2015). See Section 3.2.7 (Air Quality and Climate Change) for additional GHG discussion. Reclamation of the road includes removing the constructed embankment, re-contouring to preconstruction grades, and re-vegetating the footprint. Insulation associated with the road would be removed. Re-seeding and obtaining similar level of vegetation cover (even if initially not the full suite of native vegetation) likely would take many years, possibly decades, and the exposure of dark soils with thin cover may accelerate heat transfer during that time period. Once cover is established, the thermal regime of the area would be anticipated to eventually adjust to be similar to the adjacent terrain.

Asbestos Impacts. NOA has been documented within the project area. AIDEA has indicated that it has identified approximately twice the amount of material needed to construct in order to conservatively allow for avoiding the use of NOA-bearing materials for road construction and maintenance. If use of NOA-containing material should be needed for construction, AIDEA has committed to using them in the core of the road embankment and capping them to minimize risk of asbestos in road dust. See Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N, Section 3.2.7, Potential Mitigation Measure 5.

The potential for encountering NOA exists for all of the proposed action alternatives (see Appendix D, Table 3). Due to unconsolidated surficial deposits left from previous glacial actions the exact details of the amounts and locations of NOA are not known.[7] Appendix D, Table 3 helps to define the magnitude of potential impact. Work near areas of suspected NOA, including geotechnical investigations to evaluate asbestos presence, could pose health risks and require measures to mitigate hazards.

While OSHA, MSHA, and EPA have identified exposure limits, there is no identified safe level. Because asbestos is a known carcinogen, and exposure to asbestos fibers through inhalation may lead to the development of pulmonary diseases, comprehensive design stipulations and mitigation measures have been identified to minimize exposure. Road dust may contain low, but measurable, amounts of asbestos. If there were no mitigation or if mitigation were partially or wholly ineffective, fugitive dust emissions could be expected to have greater amounts of asbestos in areas of the roadway constructed with gravel containing NOA. Dust settling on snow, foliage, or bare ground would most affect an area approximately 328 feet (100 meters) from the roadway edge, spreading the asbestos contamination beyond the road footprint. Wind, precipitation, and vegetation disturbances (e.g., humans and animals moving through brush where asbestos fibers have settled) may cause asbestos fibers to become airborne or be washed into water bodies and drinking water sources.

AIDEA has committed to avoid cutting into the existing surface soils and plans to construct the roadway mostly on fill and minimize areas of cut slopes. It has further committed to defining NOA-containing materials as 0.1 percent NOA or greater, which is 60 percent lower than the State of Alaska definition (0.25 percent NOA). AIDEA has committed to avoid using NOA-containing materials, where feasible, for

[7] The details of the amounts and locations of NOA is relevant to protecting against adverse health impacts. However, the information is not essential to making a reasoned choice among alternatives because there is sufficient information on the relative level of risk among alternatives (see Volume 4, Map 3-2).

construction and maintenance. Where it cannot avoid the use of such materials, AIDEA has committed to following DOT&PF guidance for use of NOA materials in construction (DOT&PF 2015). No NOA-containing materials would be used for capping road and facility surfaces. Such commitments would apply for each phase of construction and for operations, maintenance, and reclamation. If these design features and BLM stipulations (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) and BLM-proposed mitigation measures (see Appendix N) are applied along the full length of the alignment and throughout the life of the road (i.e., during operations, maintenance, and rehabilitation), these would lower the potential for asbestos in road dust and acceptably limit the public health risks from asbestos exposure to local communities, road workers, subsistence users, and others passing near the proposed road or crossing it. This should not be confused with elimination of all health risk, because NOA exists in the study area and the use of materials with less than 0.1 percent asbestos does not mean those materials have no asbestos and those materials are not capable of releasing asbestos to the air or presenting a risk to human health.

Road reclamation would include removing all materials placed for the road, airstrips, and facility construction. Such actions may mobilize asbestos fibers into the air, deposit asbestos dust on adjacent vegetation, and wash asbestos into waterways. If materials containing NOA are used, all guidance for testing, handling, dust control, transportation, and construction of such materials should be followed to minimize impacts.

Metal Leaching and Acid Rock Impacts. ARD areas have been identified in the Ambler Mineral Belt, and DOWL (2011a) noted the potential for ARD along Alternatives A and B based on aerial imagery. ARD potential along Alternative C is unknown[8]. Design features proposed by AIDEA (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) and stipulations in Appendix N (assuming incorporation in the BLM decision) would result in testing for and minimizing impacts of ARD. Building mostly on fill is proposed and would minimize cuts into ARD-susceptible material. Corrosion testing during geotechnical investigations for the road and material sites would provide information to avoid cuts and use of materials with potential for ARD (see Appendix N). The impacts of the road on adjacent areas of soils and permafrost not directly affected by the road would depend largely on the amount of dust distributed as a result of traffic on the road. In some areas, fugitive dust could include measurable amounts of acid rock or asbestos in areas of the roadway constructed with gravel that contains acid rock or NOA. If acid rock or soils with an acid/base makeup different than surrounding soils were used in the cap surface of the roadbed, the relative acidity of the surrounding soils would change as a result of dust accumulating on those adjacent soils. The drainage of acidic water from the roadway or exposed ARD areas in material sites could impact surface and subsurface water quality and have an adverse effect on vegetation, soil organisms, and aquatic life. It may also influence the likelihood of minerals containing NOA releasing asbestos. If design stipulations to avoid cuts and use of materials with ARD were followed, occurrences of ARD development should be reduced. Methods could be implemented to prevent ARD, such as covering exposed surfaces, preventing exposure of iron-rich sources, and preventing water runoff across iron-rich materials (e.g., stream diversion) to reduce impacts.

It is not known at this time whether the proposed road alternative alignments transect mineralized areas in a manner that would affect or enhance leaching beyond what would be expected under undisturbed circumstances, or the No Action Alternative. Minerals with high toxicity leaching from geologic material

[8] The ARD potential along Alternative C is relevant due to its potential for the kinds of water quality impacts described in this section. The BLM determined the lack of information along Alternative C was not essential to a reasoned choice among alternatives because according to engineering reports at the time of route development, if a bedrock material site is determined to have mineralogy that could lead to ARD, a panel of acid/base tests could be conducted to definitively determine the rock's ARD potential. If a source were to be determined to have ARD potential, methods could be implemented to prevent ARD, such as covering exposed surfaces, preventing exposure of iron-rich sources, and preventing water runoff across iron-rich materials (e.g., stream diversion); or selecting an alternative site (DOWL 2019b).

in a neutral pH setting does occur and can cause impacts to soil and water quality. Once initiated, leaching and ARD can persist for hundreds of years until the sulfides are completely oxidized or the metals are leached from the rocks (INAP 2014). High levels of metals and/or acids can be harmful or toxic to living organisms. Metals absorbed by plant and animal tissue can be passed along through the food chain. The proposed road is anticipated to be constructed primarily on fill to avoid changing the existing conditions. As such, the concern would be the use of fill material that would leach metals and metalloids under neutral pH conditions. Design features put forth by AIDEA and potential mitigation measures to assess ARD potential would identify the potential for metal leaching under non-acidic conditions. Should high potential exist, the use of the material site or section would be avoided if the mitigation measures were selected.

According to AIDEA, upon road reclamation, embankment materials would be removed and placed into open material sites and covered. This proposed reclamation activity would require the opening and permitting of solid waste landfills within the project footprint. This would require ADEC authorization, and would need to be identified as part of any material site reclamation and closure plan. This would not typically be authorized by the BLM on BLM-managed lands as it would be a violation of policy based on the existing BLM Mineral Materials Handbook. Should the relative acidity change as a result of these actions, the drainage of acidic waters could also impact surface and subsurface water quality and adversely impact vegetation, soils, and the aquatic environment. Appendix N includes stipulations that would require AIDEA to prepare a detailed reclamation plan and get approval from the BLM prior to any disposal of old roadbed material on BLM-managed land.

Alternatives A and B Impacts

Although Alternative B is longer than Alternative A, the overall topography and types of geological hazards to be encountered are similar for both alternatives. Alternatives A and B primarily follow areas of mapped continuous permafrost (Jorgenson et al. 2008). The alternatives follow sections of lowlands and uplands with discontinuous to moderately thick permafrost to thin permafrost in those areas where the alternatives cross the Koyukuk and John rivers, as well as the project terminus near the Ambler River (see Volume 4, Map 3-1, and Appendix D, Table 2). The NPS estimates soil temperatures within the NPS project area are near 30°F. Permafrost temperatures outside the NPS area along Alternatives A and B are likely similar. Maximum potential for thaw settlement along Alternatives A and B ranges from 2 to 98 feet (Jorgenson et al. 2015). Research to characterize the 2050 risk of thaw subsidence for permafrost regions in Alaska based on estimates of ground ice volume, MAAT, soil texture, mean snow depth, vegetation, and presence of organic soil show serious hazards exist to northwest Alaska and Brooks Range infrastructure from warming air temperatures (Hong et al. 2014). Such risks of thaw and infrastructure damage would be expected to continue beyond 2050 beyond the life of the Ambler Road project (into the 2070s). Geotechnical investigations during design would be anticipated to seek to identify these locations and avoid areas particularly sensitive to high thaw settlement because the maintenance cost would be high.

Portions of the route for Alternative A and B pass through areas of bedrock with known potential for NOA, with some areas having high potential (2 and 3 percent of mapped footprints, respectively). Most areas with medium and high potential are not close to communities (see Volume 4, Map 3-2 helps define the likelihood and extent of impact), but the road and road facilities would start concentrating travel corridors along or across it. Road users, including freight transporters and road maintenance personnel, and subsistence users from local communities who travel through and/or use the project area (but not the road itself) for harvesting, may be exposed to fugitive road dusts containing NOA. The unevaluated surficial deposits near Alternatives A and B (91 and 86 percent of mapped footprints, respectively) are likely to have measurable amounts of NOA (see Appendix D, Table 3, which helps define the magnitude

of potential impact). If the BLM-proposed mitigation measures (see Appendix N) are applied along the full length of the alignment and throughout the life of the road (i.e., during operations, maintenance, and rehabilitation), these would lower the potential for asbestos in road dust and acceptably limit the public health risks from asbestos exposure to local communities, road workers, subsistence users, and others passing near the proposed road or crossing it.

The southern foothills of the Brooks Range have been explored, and mineral occurrences, mineral prospects, and small mines have been developed along much of these corridors. Known occurrences and prospects would likely be reevaluated regarding further development, and new mineral exploration would likely occur if Alternative A or B is selected. Approximately 26 miles of Alternative A and 18 miles of Alternative B pass through NPS-managed GAAR, in which mineral exploration and development is prohibited.

Alternative C Impacts

Portions of the Alternative C alignment cross terrain that has not been glaciated, and the alignment follows broad valley floors that likely contain fine-grained, organic, ice-rich, and frost-susceptible deposits on which it would be difficult to construct and maintain a road embankment. Over half of this alternative is within discontinuous permafrost zones and much of the remainder is in the continuous permafrost zone where the permafrost is characterized as moderately thick to thin (Jorgenson et al. 2008; see Appendix D, Table 2, which helps define the magnitude of potential impact). Thaw settlement potential along Alternative C has not been studied; however, geomorphic features in aerial imagery indicate potential for substantial thaw settlement (DOWL 2019b). Discontinuous permafrost is typically warmer than continuous permafrost, which may lead to increased or earlier warming and thawing of permafrost along this alternative compared to Alternatives A and B. Additionally, discontinuous permafrost may cause considerable differential movement. Like Alternatives A and B, risks of thaw and infrastructure damage would be expected to continue for the life of the Ambler Road project (into the 2070s).

Approximately 16 percent of the Alternative C alignment traverses areas of bedrock with "Medium" potential for NOA. This occurs in the area where Alternative C traverses the Ray Mountains. This area is distant from communities, but the road itself would be a human high-use zone. Alternative C would traverse steeper slopes than the proposed alignments for Alternatives A and B. Steep sections would be more likely to be constructed using cut sections. It may not be possible to avoid localized areas identified during geotechnical investigations as containing NOA due to topography and lack of alternative routes that could avoid such bedrock formations. Exposed rock walls may contain NOA that could mobilize through wind and precipitation. Following potential mitigation methods (see Appendix N) to control dust and minimize worker exposures would likely be more difficult and therefore more expensive in such areas, limiting its effectiveness. Avoiding such cut areas would be more effective. Surficial deposits comprising over half of the Alternative C footprint may have measurable amounts of NOA.

The ARDF lists fewer known mineral occurrences near Alternative C than near Alternatives A and B. However, several state mining claims exist in the Zane Hills and Ray Mountains. Additionally, the Alaska Division of Geological and Geophysical Surveys (DGGS) has identified high potential for critical minerals including REEs, PGEs, carbonate-hosted copper, sandstone-hosted uranium, and tin-tungsten-molybdenum near this alternative.

Combined Phasing Option

A combined construction phasing option has potential to reduce the impacts to soil and permafrost resources by limiting the duration of construction activities to a single phase of construction over fewer

years, thereby requiring less temporary construction staging and access that would cause long-term impacts to thaw-sensitive soils over consecutive construction seasons, and by eliminating the pioneer road and constructing a thicker permafrost protective embankment. Appendix N provides potential mitigation measures and the BLM's standard stipulations for reducing the permafrost degradation impacts associated with the construction and operation of the pioneer road.

Mining, Access, and Other Indirect and Cumulative Impacts

The reasonably foreseeable development scenario presented in Appendix H would result in the removal of minerals, including copper and gold, from the District for transport to market. This would be anticipated to occur under all action alternatives, as long as market conditions remained favorable. This is the reason sought by AIDEA for implementation of this project.). Actions from other non-road reasonably foreseeable development, as described in Appendix H, could contribute to the impacts.

The mines, industrial access road, and associated facilities would transect areas with existing geological hazards as well as unfavorable soil and subsurface conditions. These include corrosive subsurface minerals; liquefiable soils; and organic-rich, ice-rich, poorly drained, or thaw-sensitive permafrost soils. Geotechnical investigations conducted during the design phase would identify these issues, and the mines, roads, and associated facilities would be designed and constructed to avoid and minimize their risks using appropriate and standard design practices. Soil and geological hazards may be addressed by modifying alignments, choosing appropriate cut and fill geometry, implementing slope and/or embankment stabilization measures, using wider and thicker embankments on thaw-sensitive permafrost to reduce thaw settlement, and developing designs to resist seismic hazards.

Industrial mining and authorized commercial uses of the selected alternative are anticipated to spur the construction of additional access roads and facilities. Such development would result in additional localized changes to area geology, topography, and subsurface soils. Disturbances to the soil thermal regime would exacerbate permafrost thawing in the area.

Spur roads and mine development plans would expand the geographic scope of ground disturbance and dust deposition. In addition, actions that cause or exacerbate erosion may release or wash NOA into streams or other waterbodies. Impacts could be mitigated if spur roads leading to the selected alignment are engineered and the locations at which they connect to the project road are carefully chosen to lessen the potential impact on subsurface soils, existing permafrost, and the project road. Engineering design measures, including careful selection of connection locations to the project road and maintenance procedures, can reduce, but should not be considered completely effective at avoiding, changes to the soil regime. Some permafrost may thaw and result in changes and impacts.

Additional ground-disturbing road construction and mine development may disturb the existing placement of NOA and acid-bearing rock in the area. Use of NOA materials in construction would expose workers both during construction and during operations. Asbestos fibers are a known health risk if disturbed or released into the air (see Chapter 3, Section 3.2.7 [Air Quality and Climate]). State of Alaska material use guidance and standards address the use of NOA materials on projects, but does not address mining activities such as rock crushing and blasting. The development and operations of the mines would be regulated by multiple laws and authorities, including the Clean Air Act (CAA) and Safe Drinking Water Act; federal agencies with asbestos regulations, including OSHA and MSHA; and state agencies, including ADEC and ADNR. Some local communities are anticipated to connect to the fiber-optic line that AIDEA has proposed to bury within the proposed roadbed. If these local spur connections use trenching techniques to bury fiber-optic lines outside of local connector road embankments, that activity could have adverse localized impacts on soils and permafrost. Recent fiber-optic cable installation adjacent to the Dalton Highway has caused permafrost degradation and the development of thaw ponds

(Grove 2018). As permafrost degrades, it becomes more prone to erosion; thawing makes sediments unstable, which leads to increased erosion and sedimentation. Above-ground connections or best installation practices would minimize impacts of community connections.

If the Ambler Road and associated facilities are ultimately removed after mining activity ceases, any spur roads that may develop (e.g., roads to facilitate commercial connections to communities) could be abandoned, or fall into disrepair due to lack of local finances to remove and reclaim. Dust suppression activities would likely be suspended, but use by the local community likely would continue to occur as long as the road was drivable for access to adjacent land. See Section 3.3.1, Vegetation and Wetlands, and 3.3.2, Fish and Aquatics, for discussion of impacts to wetlands and fish habitat, respectively.

3.2.2 Sand and Gravel Resources*

Affected Environment

DOWL (2011a) studied potential borrow sources for Alternatives A and B based on previous DGGS studies (Reger et al. 2003a–2003g). DOWL (2011a) mapped ice-rich morainal silty gravels along these routes, but stated that less silty, Quaternary alluvial and glacial outwash gravels may be present locally. DOWL (2011a) estimated that material sources consisting of floodplain alluvium, silty alluvium, and bedrock would be available approximately every 5 to 10 miles along Alternatives A and B. A review of aerial imagery, geologic maps, and topographic maps along Alternative C indicates the majority of borrow sources would likely be in bedrock, and material source spacing would vary from approximately 5 to 30 miles. Silty alluvial sources may be present in river floodplains or local glacial outwash deposits.

Environmental Consequences

Road Impacts

The construction of the road would require large amounts of sand and gravel, embankment material, and aggregate resource, as well as sources of riprap. The current and future characteristics of subsurface soils and final road design dictate the volume and quality of material resources required for road construction. Field studies, site-specific explorations, and laboratory testing would be conducted to evaluate potential material sources and available material quality and quantities.

AIDEA has identified potential material sources along each alternative of sufficient volumes to construct the project and provide additional materials needed for routine maintenance and repairs of areas experiencing thawing and subsidence. Geotechnical investigations supplying data on the specific sizes, grades, and actual quantities have not been conducted. The footprint of each alternative includes anticipated material site development areas; therefore, impact assessments throughout this Supplemental EIS address impacts associated with material site development, including wetlands and vegetation, fish and wildlife habitat, air quality, and soils. While the volume of overburden at the proposed material sites is unknown, geotechnical engineers estimated that the provided footprint incorporates the stockpiling of removed soils to reach suitable construction material.

It is not currently known if there are sufficient volumes of materials that are clean of NOA. Surficial deposits that have not been evaluated are likely to have come from such bedrock ground down by previous glacial action. It should be anticipated that measurable concentrations of asbestos may be present in unconsolidated surficial deposits near bedrock with high or medium potential for NOA (see Volume 4, Map 3-2, to help understand extent and likelihood of impact). Potential material sites would be investigated and tested to determine if asbestos is present. DOT&PF has guidance for excavation activities and testing procedures for material sites (DOT&PF 2012).

If NOA is determined to be present, and no alternative material sites without asbestos are available, AIDEA has committed to complying with DOT&PF's *Interim Guidance and Standards for Naturally Occurring Asbestos (NOA) Material Use* (DOT&PF 2012), which includes procedures for testing and minimizing dust, and specifies where the materials may be used and not used. For example, roads would need to be either paved or capped with materials free from measurable NOA.

No Action Alternative Impacts

There would be no demand on local sand and gravel material sources, or change to the existing placement of NOA or acid-bearing rocks due to this project, and therefore no impacts on these resources under the No Action Alternative.

Impacts Common to All Action Alternatives

Potential impacts from road construction and maintenance include the removal of sand, gravel, and bedrock resources for embankment fills and road surfacing from material sites. The development of material sites would affect vegetation cover, topography, drainage patterns, the thermal regime of subsurface soils, wetlands and aquatic resources, wildlife and birds, and air quality (e.g., fugitive dust). The BLM could require mitigation for impacts from material sites be included in specific material site mining plans on BLM-managed lands. Appendix N provides potential mitigation measures and BLM's standard stipulations for material sites. If these mitigation commitments were applied, they would avoid, minimize, and potentially compensate for unavoidable impacts from material site development that could expose ARD or NOA materials to the environment, with associated impacts (see Appendix N, Sections 3.2.1 and 3.2.2). AIDEA has proposed site-specific geotechnical explorations be performed to evaluate potential material sites (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Such geotechnical testing would be expected to identify the presence of ARD or NOA to avoid unnecessary cuts and unintentional exposures.

Material containing asbestos, defined by the State of Alaska as more than 0.25 percent, can be used within the road embankment if it is sufficiently capped or paved (DOT&PF 2012). The applicant has proposed to avoid the use of NOA materials to the greatest extent feasible. If NOA materials are the only feasible option for road construction, AIDEA would follow DOT&PF's guidance (DOT&PF 2015) and standards for NOA material use (17 AAC 97). Following this guidance would be mostly effective at reducing impacts to air quality from dust generated or mobilized during construction, operations, and maintenance activities (see Appendix N, Section 3.2.7). In its comments on the Draft EIS, AIDEA clarified its own design measure and committed to avoiding the use of any construction and maintenance materials that exceed 0.1 percent NOA, to the greatest extent possible (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA), or would follow state design measures to contain NOA materials in the core of the road embankment. The BLM has proposed mitigation measures that would require AIDEA to develop a comprehensive plan to address NOA and demonstrate compliance (see Appendix N, Section 3.2.7). As noted in Section 3.2.1 (Geology and Soils), neither the state definition of NOA materials, which is materials containing more than 0.25 percent NOA, nor AIDEA's proposed threshold (avoiding materials that contain more than 0.1 percent NOA) is based on levels that have been determined safe to breathe. OSHA standards are based on measurements of the concentration of asbestos fibers in air over time, and OSHA acknowledges that this level does not eliminate health risk (Jeffress 1999).

According to AIDEA, upon reclamation of the road, borrow materials would be removed and placed in open material sites. It is unknown whether such materials would be usable for other construction projects. This proposed reclamation activity would require the opening and permitting of solid waste landfills within the project footprint. This would require ADEC authorization, and would need to be identified as part of any material site reclamation and closure plan. This would not typically be authorized by the BLM

on BLM-managed lands as it would be a violation of policy based on the existing BLM Mineral Materials Handbook. Appendix N includes stipulations that would require AIDEA to prepare a detailed reclamation plan and get approval from the BLM prior to any disposal of old roadbed material on BLM-managed land.

Alternatives A, B, and C Impacts

Estimated required borrow material for road construction under the action alternatives would be approximately 15 million cubic yards (Alternative A), approximately 16.8 million cubic yards (Alternative B), and approximately 22 million cubic yards (Alternative C; DOWL 2019b). DOWL estimated that material sources would be available approximately every 10 miles along: 93 percent of Alternative A (DOWL 2019b), consisting of floodplain alluvium, silty alluvium, and bedrock (DOWL 2015); 95 percent of Alternative B (DOWL 2019b), consisting of floodplain alluvium, silty alluvium, and bedrock (DOWL 2015); and 84 percent of Alternative C (DOWL 2019b). A review of aerial imagery, geologic maps, and topographic maps along Alternative C indicates the majority of borrow sources would likely be in bedrock, and material source spacing would vary from approximately 5 to 30 miles.

Sand and gravel mining would alter the geomorphic landforms and remove vegetation, leading to permafrost thaw and resulting in subsidence, formation of thaw bulbs and changes to drainages in and around the perimeter of a material site. Appendix N addressed proposed mitigation measures and effectiveness of the measures to reduce impacts associated with sand and gravel mining.

Combined Phasing Option

The impacts from the combined phasing option would have the same effects as the other alternatives.

Mining, Access, and Other Indirect and Cumulative Impacts

Indirect and cumulative impacts include the change of topography, drainage, and thermal regime due to material site and access road development. These changes may lead to permafrost warming or thawing, which may affect road performance and maintenance and water quality. Locations of material sites and access roads should be chosen and designed based on site-specific geotechnical explorations to mitigate these potential indirect impacts (see Appendix N).

Indirect future actions, such as additional ground-disturbing road construction and mine development, may disturb the existing placement of NOA and acid-bearing rocks in the area. State of Alaska material use guidance and standards address the use of NOA materials on projects, but does not address mining activities such as rock crushing and blasting. The development and operation of the mines would be under the auspices of multiple agencies and laws, including the CAA and Safe Drinking Water Act; federal agencies with asbestos regulations, including OSHA and MSHA; and state agencies, including ADEC. See Appendix H for additional details on mining and other reasonably foreseeable development impacts.

3.2.3 Hazardous Waste*

Affected Environment

Hazardous waste is not a resource that could be affected by the proposed project; rather, it is a potential condition in the environment that could affect natural resources and human health if exposed to air, water, or soil pathways. The physical environment section of this chapter discusses hazardous waste because it is often found buried or has spilled and seeped into the soil or groundwater. The project area has had limited human or industrial activities that could have resulted in solid or hazardous wastes being introduced into the environment. Localized spills and contaminated sites are present near existing communities and along the Dalton Highway and Trans-Alaska Pipeline System (TAPS), which form the eastern boundary of the

project area. ADEC's contaminated sites database indicates there are no contaminated sites within 5 miles of Alternatives A and B; however, 17 contaminated sites are located within 5 miles of Alternative C, with the closest active site located approximately 1.5 miles away (see Appendix D, Table 4, and Volume 4, Map 3-3).

Environmental Consequences

Road Impacts

Construction and operation of the roadway would involve use of chemicals, production of solid waste, and transport of chemicals, explosives, and solid waste in an area with limited human or industrial activity, which could result in solid or hazardous wastes being introduced into the environment. The road project would be anticipated to include the transportation, storage, and use of diesel and other fuel products; oils and lubricants for road construction and maintenance of equipment; and dust palliatives. Transportation on the road would include the movement of fuels (including liquefied natural gas for mine power production), chemicals, explosives, and supplies to support the development and operation of the mines, as well as the movement of wastes and ore concentrates. All of these actions involve substances that could be toxic to organisms, including humans. State and federal laws govern transport and handling of such materials, and Appendix N includes potential mitigation measures that may be applied to this project.

While gravel road dust consists mainly of relatively inert mineral particles, these particles are typically laden with trace chemical contaminants originating from vehicle exhaust emissions and the wear and tear of vehicle components, such as brakes (copper, nickel) and tires (zinc, cadmium), and chemicals used in the maintenance of roads, including deicing and dust abatement treatments, as well as herbicides applied for control of invasive weeds (EPA 2014). Road dust of industrial roads may also become contaminated by the materials hauled on the roadway (EPA 2009).

Impacts from spills vary, based on the material type, size, and season. Substance behavior—if released into the environment—is influenced by environmental factors (current weather or season), the environment onto which the spill occurs, and the physical and chemical properties of the spilled material. Appendix D, Table 5, describes potential spill behavior during the 4 seasons, as described in the Alpine Satellite Development Plan EIS (BLM 2004a). The table helps to define the potential magnitude and extent of spills. A spill prevention, control, and countermeasures plan would be developed to guide construction and operation activities. The plan would identify measures to reduce the potential for fuel spills, locations of spill response materials, and training of construction and maintenance staff on spill response.

No Action Alternative Impacts

Under the No Action Alternative, there would be no generation of solid waste, wastewater, or spills of oils or other hazardous substances; use of chemicals; production of solid waste; or transport of chemicals, explosives, or solid waste in the project area attributable to the project. However, mineral exploration supported by aircraft would continue under the No Action Alternative, and the use of chemicals, production of solid waste, or transport of chemicals or solid waste from exploration activities would be limited to existing airfields and access roads within the project area.

Impacts Common to All Action Alternatives

All action alternatives would generate solid waste consisting of food wastes, sewage sludge, and other nonhazardous burnable and non-burnable wastes from road construction, operations, and maintenance. Solid wastes would be separated and stored in approved containers until they were incinerated or

transported to an approved landfill. Burning waste would temporarily affect air quality. Construction and maintenance activities are anticipated to include the use of dust palliatives (also known as dust suppressants) to reduce particulate concentrations in the air. These may introduce chemical contamination into the surrounding environment and waterbodies. The accumulation of low levels of persistent contaminants over long periods of time can impact ecosystems that have only experienced minimal industrial pollutants. AIDEA proposes the use of dust palliatives and the latest technologies for dust minimization (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). A potential BLM mitigation measure under consideration by the BLM would ensure that dust control palliatives be selected to minimize toxicity to fish. Potential BLM mitigation measures include additional methods to minimize such impacts (see Appendix N).

Spills are not a planned activity and are unpredictable in cause, location, size, time, duration, and material type. However, they are likely to happen, given the expectation of regular use of the road over a 50-year period by vehicles, all of which are likely to require fuel and lubricants. A large percentage of vehicles on the industrial road would transport bulk shipments of fuel or chemicals. The majority of construction spills tend to be relatively small amounts of refined products, such as gasoline, diesel, and lubricating and hydraulic fluids resulting from vehicle and construction equipment fueling and maintenance. Most small spills would likely occur on the road prism (road surface and road embankment).

A tanker truck or ore concentrate accident or a fuel storage tank failure are the most likely source of large spills. If a large spill occurs, hazardous materials would be more likely to impact waterbodies or sensitive resources. Spills may occur due to trespass on the road; these spills would be minimal based on the size of materials a personal vehicle could carry and the frequency of use on the road (assuming there would be less than 1 average annual daily traffic from trespass). Spills from trespass would be cleaned up by the entity/person who spilled it or, if unreported, it would be the responsibility of the entity managing the project.

Chemicals used in mining processes would be transported along the ROW. The applicant provided a list of commonly used chemicals anticipated to be shipped via the road, including copper sulfate, hydrochloric acid, lime, methyl isobutyl carbinol, sodium cyanide, sodium diisobutyldithiophosphinate, sodium isopropyl xanthate, sulfuric acid, zinc sulfate, and adipic acid (DOWL 2016a). The actual chemicals transported could change depending on final mining operation plans and permit stipulations. These chemicals are toxic and would be transported dry or in sealed containers to minimize risk of exposure to humans and the aquatic environment should a vehicle collision or rollover occur. Permits and authorizations for the mines would address transportation, storage and usage, and emergency response procedures for hazardous materials used in mining activities.

Mining activities to extract minerals would also result in ore concentrates that may contain toxic dusts, including lead, copper, and zinc. The applicant has committed to requiring mineral concentrates be loaded into specialized (sealed) intermodal bulk shipping containers for transport to port. With this containerized system, metal releases from the transport of ore concentrate would not be expected to be commonplace.

The most common model used in EIS analyses to estimate the number of accidents involving trucks transporting ore concentrate is the equation N = RT.[9] This equation is used to estimate the potential spills from trucks transporting ore concentrate which may occur during the life of the project in all alternatives, and the following R values estimate the range of projected spills. R equals 1.87 × 10^-7 (Harwood and Russell 1990) and is similar to the national average (2010–2017) for accident rate per vehicle mile of large trucks carrying hazardous materials of 1.62 × 10^-7 (Lubetkin 2022). However, comparing the rate

[9] N is the number of predicted accidents, R is the rate of accidents per mile traveled, and T is the total traveled miles.

of spills to 5 major mines in Alaska, the prediction of accidents associated with spills of hazardous materials is underestimated. When R is adjusted based on observed ore concentrate spill rates at 5 major mines in Alaska (Pogo, Kensington, Greens Creek, True North/Fort Knox, and Red Dog) R equals 4.95 × 10^-6 (Lubetkin 2022).

Diesel fuel, gasoline, lubricants, liquefied natural gas, listed chemicals, and ore concentrates could be toxic to plants, animals, and people, sometimes at low concentrations in air, water, or soil. Uncontained larger spills that left the gravel road embankment could kill or damage plants, fish, wildlife, and human road users and pollute water, soil, and air.

All action alternatives have similar total transportation lengths to and from Fairbanks. All action alternative embankments would be surrounded by approximately 60 percent wetlands and waterbodies within 328 feet (100 meters; see Section 3.3.1, Vegetation and Wetlands). Contaminant releases near wet areas and beyond the gravel embankments would have short migration pathways to aquatic habitat. Once contaminants reach unfrozen waterbodies, clean up and removal would be difficult.

Because the area is remote and little infrastructure exists, the existing capacity for response to spills is limited. While the statewide capacity for oil spill response is well established, there is minimal capacity to handle a spill of liquefied natural gas or chemicals such as sodium cyanide. AIDEA's design features include development of a spill prevention and response plan to comply with regulations regarding spill prevention, containment, preparedness, and response (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Appendix N, Section 3.2.3 (Hazardous Waste), outlines potential mitigation measures for hazardous waste, solid waste, and fuel handling and transport. If such commitments are applied, the potential risk of spills may be reduced, and adverse impacts from resulting spills may be minimized but are not expected to be eliminated.

Alternatives A and B Impacts

Construction of Alternative A or B would be shorter than C, resulting in less vehicle equipment and vehicle maintenance associated with the construction activities. This may result in less incidences of construction-related leaks and spills. The shorter distance to the Dalton Highway with Alternatives A and B, however, results in longer driving distances on the Dalton Highway and increased risk of fuel truck spill on the highway relative to Alternative C. The controlled access of the proposed road may reduce the likelihood of spills. Potential range of accidents involving trucks carrying ore concentrate for the life of the project would be between 258.6 and 6,844.7 (121.0 and 3,202.3 from the new roadway and 137.6 and 3,642.4 from the Dalton Highway), or approximately 5.2 to 136.9 annually, for Alternative A and between 268.3 and 7,102.7 (130.7 and 3,460.3 for the new roadway and 137.6 and 3,642.4 for the Dalton Highway), or approximately 5.4 to 142.1 annually, for Alternative B (Lubetkin 2022).

Alternative C Impacts

Where Alternative C traverses the Ray Mountains, the alignment is anticipated to have more steep sections than Alternatives A and B, which could result in more difficult driving conditions and more risk of contaminant releases as a result of vehicle accidents. The Alternative C alignment also crosses more streams and follows several streams, resulting in a greater percentage of the alignment in or within 1,000 feet of estimated floodplains (see Section 3.2.5, Water Resources), which could increase risks of contaminant dispersion and difficult cleanups. Potential range of accidents involving trucks carrying ore concentrate for the life of the project would be between 270.0 and 7,148.2 (190.3 and 5,038.7 for the new

roadway and 79.7 and 2,109.6 or the Dalton Highway), or approximately 5.4 to 143[10] annually (Lubetkin 2022).

Combined Phasing Option

Construction of the combined phasing option would result in a shorter construction time for all action alternatives, resulting in less vehicle equipment and vehicle maintenance associated with construction activities. This option would also reduce the use of chemicals, production of solid waste, or transport of chemicals, explosives, or solid waste associated with construction, which may result in fewer incidences of construction-related leaks and spills of hazardous materials.

Mining, Access, and Other Indirect and Cumulative Impacts

Reasonably foreseeable development actions would increase the potential of spills in the project area. Development and operations of large-scale mining operations in the District would likely include the transportation of liquefied natural gas by tanker truck, in addition to diesel fuel and other petroleum products. Spills and leaks from mine site equipment and tailings facilities would be additive and have potential to be larger because some container sizes would be larger.

Mineral exploration supported by aircraft would continue albeit at a much lower rate without this project, and the use of chemicals, production of solid waste, or transport of chemicals or solid waste from these activities would be limited to existing airfields and access roads within the project area. The BLM is evaluating the potential to revoke existing 17(d)(1) withdrawals in 5 planning areas, including the Kobuk-Seward Peninsula Planning Area. If these withdrawals are revoked, further development would occur on those parcels, which could increase the risk of spills in the planning area.

Spills and potential risk of spills as a result of the development and operation activities of mines as identified in Appendix H are more predictable and more serious than those discussed above as part of the proposed road project. Toxic chemicals would be stored on site as part of any developed mine and used as part of their ore extraction and concentration process. Spills during transportation and storage/use of hazardous materials are more likely to occur the more such materials are shipped, transferred, and handled. Given the scale of mining that is likely to be undertaken and the relatively large number of trucks hauling fuels, other materials, and ore over nearly 50 years (see Table 25 in Appendix H), a small percentage of truck traffic operating part of the year in winter weather and darkness is likely to be involved in crashes, mechanical malfunctions, or loading/unloading errors, and these could result in release of hazardous materials. The likelihood of substantial environmental effects is considered low, but there is a small risk that the effect could be substantial—for example, if a large volume of toxic material spilled directly into flowing water of an anadromous fish stream and escaped before a response could be mounted.

Any contaminants released to the environment through any activity made possible by the road, including but not limited to large-scale mining, would be addressed in coordination with the ADEC and EPA. The action taken to remediate environmental impacts of the release would be site specific, protective of human health and the environment, and consistent with all environmental laws and regulations. The ADNR Office of Project Management and Permitting typically coordinates large mine permitting. ADNR Division of Mining, Land and Water, Dam Safety and Construction Unit, would review dam design and operation for state certification, and ADEC would issue permits to authorize the disposal of tailings, waste rock and wastewater, and ensure compliance with applicable water quality standards. Regardless,

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[10] This is for the new road length of 332 miles, adding length along the Dalton Highway. the potential spills annually would be between 5.4 and 143.0.

tailings dam failures occur and could have major adverse effects to water quality, fish and wildlife habitat, fish and wildlife mortality, and human mortality.

It is not possible to state with specificity spill impacts from mining because no specific mining proposal has been made. However, the risk of spills and impacts from spills are anticipated to be similar to those experienced at the Red Dog Mine (EPA 2009) and discussed in the spill risk assessment in the Donlin Gold EIS (USACE 2018).[11] The EIS evaluated spill risks and associated impacts from spills of diesel fuels, liquefied natural gas, and chemicals used in ore processing, and mine tailings stored behind a tailings dam. These are representative of the types of spills and impacts that can occur in mining operations.

Section 311 of the Clean Water Act establishes requirements related to discharges or spills of oil or hazardous substances. Under 40 CFR 112, the EPA would require any mining facilities that handle substantial quantities of oil to prepare a Spill Prevention, Control, and Countermeasures Plan. See Appendix H for additional details on mining and other reasonably foreseeable development.

3.2.4 Paleontological Resources*

Affected Environment

Paleontological resources include fossilized and non-fossilized remains of ancient life. According to the BLM (2006 and 2016a), little work has been done to inventory paleontological materials on BLM-managed lands in the Kobuk-Seward Peninsula and Central Yukon planning areas. However, a wide range of vertebrate, invertebrate, and plant fossils are known across the area. The Kobuk-Seward Peninsula planning area, which intersects the western portion of the project, contains 171 occurrences of paleontological resources on BLM-managed lands, and additional Pleistocene fossils are known to occur in numerous coastal and riparian contexts on non-BLM-managed lands in the planning area. The nature of the paleontological resources in the Central Yukon planning area spans the Paleozoic Era (approximately 540 to 250 million years ago) to the Cenozoic Era (approximately 65 million years ago to present). All types of vertebrate and invertebrate animals and plant specimens are reported, with the large mammal vertebrate remains concentrating in the Pleistocene epoch (approximately 1.8 million to 10 thousand years ago). Vertebrate fossils within the planning area typically fall within the Pleistocene or Cretaceous (approximately 144 to 65 million years ago) age classes, with the earlier Cretaceous being much rarer (BLM 2016a: Section 2.1.2, Soil Resources). Another significant class of vertebrate fossils in the Central Yukon are those of extinct large mammals characteristic of the Mammoth Steppe fauna from the late Pleistocene or ice age time period as well as mummies of other glacial-age animals (Harington 2011). Most specimens have been washed out of their original positions and are often found on stream margins or at the base of placer mines, so an overall understanding of the geologic context for these paleontological resources is still lacking for the region (Guthrie 1968). These Pleistocene fossils are fairly common in the drainages of the Central Yukon in areas that have not been subjected to intensive post-depositional glacial-ice scouring (BLM 2016a). The nearest published Pleistocene age mammalian fossils were found in fluvial deposits in the Central Yukon (Churcher et al. 1993).

While geologic mapping is often used to determine areas likely to contain fossils, the known distribution of fossil occurrences in the Central Yukon is primarily a result of limited scientific inventory and placer mining and is likely only a small portion of the fossils in the area (BLM 2016a).

[11] In this Supplemental EIS, the analysis relies on studies associated with current or proposed mines in Alaska. It should be noted, however, that Donlin is a gold mine and Red Dog is a lead/zinc mine; these mines' products are different than those that would be primarily produced by mines in the District (i.e., copper, cobalt).

The BLM is required to use the Potential Fossil Yield Classification (PFYC) system, which is a tool for assessing potential occurrences of paleontological resources in mapped geologic units. The PFYC system provides baseline information for assessing paleontological resources and provides a consistent approach to determine if an action may affect paleontological resources on public lands. The system is created from available geologic maps and assigns a class value to each geologic unit. PFYC values range from Class 1 (very low) to Class 5 (very high) and indicate the probability for the mapped unit to contain significant paleontological resources and the degree of management concern for the resource. Geologic units without enough information to assign a PFYC value are assigned Class U (Unknown Potential). These could include geological units where conditions would indicate that significant resources could be present, but there is little actual data in the area, reports of paleontological resources exist but have not been verified, or the area or geologic unit is poorly studied. PFYC values for geologic units in Alaska were first assigned in 2010 (Armstrong 2010), and an updated geospatial PFYC model for Alaska is currently being developed. Based on preliminary results, PFYC values for the mapped geologic units in the project area range from Class 1 (very low) to Class 2 (low). No Class 3, 4, or 5 values are identified. Class U values are present but are primarily assigned to bodies of water.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Current changes to paleontological resources, such as increased exposure due to changes in permafrost, riverbank erosion, and weathering, would continue to occur. There would be no potential direct impacts on paleontological resources as a result of the project under the No Action Alternative.

Impacts Common to All Action Alternatives

While the potential for impacts to paleontological resources is considered low across all Alternatives, direct impacts on paleontological resources could occur during material site development, gravel mining due to construction, in areas cut for roadway or airstrip construction, and during road closure and reclamation. These direct impacts could include the direct damage or destruction of fossils as well as the disturbance of the stratigraphic context of the fossils. Additionally, the removal of ground cover could expose fossil-bearing units that would then expose the unit to weathering influences, which may damage the resource and its context.

While the proposed road would not be open to public access by design, improving access to areas with paleontological resources for both authorized and unauthorized users may result in unauthorized fossil removal, looting, and damage. Additionally, since the paleontological resources in the project area have not been extensively studied, infrastructure construction may support additional scientific research and identification of paleontological resources (e.g., during geotechnical testing, road cuts, or further cultural resource investigations).

Most specimens have been washed out of their original positions and are often found on stream margins or at the base of placer mines so an overall understanding of the geologic context for these paleontological resources is still lacking for the region. However, areas of disturbance such as river gravel borrow pits, roadcuts, and clearings all have potential to reveal paleontological resources including vertebrates.

There would be no additional impacts to paleontological resources from ice roads and pads as these would only be used during winter construction season, during which time paleontological resources would be inaccessible due to snow and ice cover.

Appendix D, Table 7, summarizes anticipated acreage of impacts on PFYC units and helps define the likelihood and magnitude of impact. Volume 4, Map 3-4, illustrates the locations and extent of potential impact. No Class 3 (moderate), 4 (high), or 5 (very high) acreages would be impacted, although some areas have unknown potential along Alternative C. Impacts on Class W (water) would be mitigated by bridge structures.

Alternative A Impacts

The Alternative A footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. Alternative A has the smallest acreage of disturbance of any alternative; while no alternative contains area in PFYC 3, 4, or 5, less disturbance would likely result in fewer potential impacts to paleontological resources. See Appendix D, Tables 6 and 7, and Volume 4, Map 3-4, for more detailed descriptions. The Alaska Paleontological Database (Zhang & Blodgett, n.d.) lists 462 recorded paleontological localities in the project area under Alternative A.

Alternative B Impacts

The Alternative B footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. The Alternative B footprint disturbs approximately 600 more acres than Alternative A due to its longer length. However, based on the PFYC classification, the potential for paleontological resources in the project area is unlikely. The Alaska Paleontological Database (Zhang & Blodgett, n.d.) lists 535 recorded paleontological localities in the project area under Alternative B. See Appendix D, Tables 6 and 7, and Volume 4, Map 3-4, for more detailed descriptions and project classifications.

Alternative C Impacts

The Alternative C footprint crosses geologic units identified as Class 1 (very low) and 2 (low) for paleontological resources. Alternative C footprint impacts the most acreage of all alternatives due to its longer length. Alternative C has the only acreage (406 acres) with a PFYC class of U (unknown potential). This area would be identified as a medium to high management concern until field surveys or additional research is performed. The Alaska Paleontological Database lists 336 recorded paleontological localities in the project area under Alternative C (Zhang & Blodgett n.d.) See Appendix D, Tables 6 and 7, and Volume 4, Map 3-4, for more detailed descriptions.

Combined Phasing Option

The combined phasing option uses the same footprint as Phase 2 in all alternatives and would therefore have the same impacts to paleontological resources as the non-combined phasing option. As stated above, the proposed road passes through geologic units identified as Classes 1 and 2 (and Class U for Alternative C); therefore, it is considered unlikely that paleontological resources would be found in the project area, except for areas classified as U under Alternative C.

Mining, Access, and Other Indirect and Cumulative Impacts

Ground-disturbing activities from past and present activities (see Appendix H) may have affected paleontological resources in the project area in areas of mineral exploration or community infrastructure construction for airports or local roads. Reasonably foreseeable future actions (see Appendix H) that could affect paleontological resources include mine and road development in the project area. All paleontological resources are protected from removal, damage, or destruction on federal lands, unless permitted, under the Paleontological Resources Preservation Act (16 USC 470aaa – 470aaa-11) and on state lands under the Alaska Historic Preservation Act (AS 41.35). Activities with the potential to

adversely affect paleontological resources are typically required to have professional inventories filed with the BLM before specific development projects begin (BLM 2018a). These include requirements to minimize or eliminate adverse impacts on paleontological resources. Mine and road development on state-owned lands would be required to coordinate with the state land manager, as stipulated under the Alaska Historic Preservation Act (AS 41.35), which specifically covers fossils and fossil localities. The effects of climate change could influence the rate or degree of permafrost melting, resulting in exposure or damage to paleontological resources, contributing to potential cumulative impacts. The No Action Alternative would have no potential cumulative impacts on paleontological resources.

The road would be a restricted access industrial road with no allowable public access. However, it is reasonable to assume that local residents as well as other residents in Alaska would seek ways to access the road both lawfully and unlawfully. This could result in increased accessibility of known and unknown paleontological resources resulting in damage, destruction, and looting. This may also result in additional scientific research and identification of paleontological resources and may help broaden the paleontological understanding of the Central Brooks Range region.

3.2.5 Water Resources*

Affected Environment

Overview

The water resources of the region are influenced primarily by climate and topography. Moderately warm summers and cold winters prevail, with mean daily temperatures below freezing from the beginning of October through the end of April and snowfall occurring from September to May. Average annual precipitation is 17 inches, but varies slightly throughout the area due to microclimate conditions such as elevation and topography (BLM 2016a). The project area has limited coverage from meteorological or hydrological recording stations. Some climate records are available from the National Centers for Environmental Information for Bettles and Coldfoot, Hogatza River, and Kiana and Selawik on the east, south, and west sides of the project area, respectively. Appendix D, Tables 8 through 12, show data for these stations. Appendix D, Tables 8, 9, and 11, show mean monthly precipitation values for Coldfoot, Bettles, and Selawik.

Surface Waterbodies

The topography of the project area defines the drainage basins, major rivers, and general direction of flow. The area is generally comprised of the Yukon River watershed and its tributaries, which enters near the southern boundary of the project area where it crosses the Dalton Highway and flows southwest to the Bering Sea (see Volume 4, Map 3-5). Large rivers joining the Yukon include the Ray, Big Salt, Tozitna, Melozitna, and Koyukuk rivers. The Brooks Range, to the north, is the headwaters for many of the rivers flowing south and then west. The Koyukuk basin rises in the Chandalar Shelf east of the Dalton Highway and parallels the highway south, and then west, to join the Yukon River south of the project area and empty into the Bering Sea. Large rivers joining the Koyukuk include the Wild, John, Alatna (includes the Malamute Fork of the Alatna), Indian, Hughes Creek, and Hogatza rivers. The Kobuk basin rises in the Brooks Range and flows south and then west to the Chukchi Sea. Large rivers joining the Kobuk include the Reed, Mauneluk, Kogoluktuk, Shungnak, and Ambler rivers and Beaver Creek. Volume 4, Map 3-6, depicts these major rivers and lakes, and Appendix D, Table 13, lists the large rivers, headwater origins, receiving waters, drainage areas, and alternatives that cross them. Special condition number 24 of the USACE CWA Section 404 permit requires that the road "not interfere with the public's right to free navigation on all navigable waters of the U.S." as determined based on current or historic commercial use (USACE 2020).

In addition to the large rivers noted above, hundreds of named and unnamed smaller rivers and streams intersect the proposed alternatives, requiring 44 to 509 additional bridge (small and medium) and culvert (moderate and major) crossings as identified in Appendix D, Table 17. These smaller rivers and streams provide water conveyance, fish habitat, floodplain storage, and watercourse/wetland connectivity. An additional 2,864 to 4,076 minor culverts (3-foot diameter or smaller), as identified in Appendix D, Table 17, will be required to maintain hydrologic connectivity and existing drainage patterns along the proposed alternatives. Minor culverts would be used to convey runoff at topographic low points, connect wetlands and surface water features, prevent ponding that may impact permafrost, and may convey smaller ephemeral and perennial streams. Special condition number 6 of the USACE CWA Section 404 permit requires that the final cross-drainage culvert locations be determined in the field during breakup, with locations staked, to ensure that existing (natural) drainage patterns are maintained throughout all construction and operation periods and that hydrology is not altered.

According to BLM's *Central Yukon Resource Management Plan, Analysis of Management Situation* (BLM 2016a), streams typically have low dissolved solids, dissolved oxygen near saturation, and neutral to moderately basic pH. Water temperatures during summer are typically less than 57°F. Appendix D, Table 14, provides the location, period of record, and type of data collected from the U.S. Geological Survey (USGS) gages. Appendix D, Table 15, provides similar data from the University of Alaska Fairbanks–Water and Environment Research Center stations. Volume 4, Map 3-6, shows the distribution of the river monitoring stations within the project area.

Several large lakes exist along the northern routes (Alternatives A and B) near the southern boundary of GAAR, including Walker Lake, Nutuvukti Lake, Lake Selby, and Narvak Lake (within the preserve), and Iniakuk Lake, Norutak Lake, Lake Minakokosa, Avaraart Lake, and Kollioksak Lake (outside the preserve). Large lakes along the Alternative C route include Klalbiamunket Lake (near Hughes) and Lake Tokhaklanten, but no information on their water quantity, quality, or bathymetry is available. The many small lakes within the project area are located primarily along the lower gradient sections of the rivers or wetland areas. Lakes are prevalent along the Kobuk River, Kogoluktuk River, Mauneluk River, Pah River Flats, and Kanuti National Wildlife Refuge (NWR), including the Kilolitna, Kanuti, Alatna, John, Wild, and Koyukuk rivers. No information on water quantity, quality, or bathymetry for these lakes was available[12].

The ADNR Division of Mining, Land and Water maintains a list of water rights and temporary use authorizations for subsurface and surface sources. Limited surface waters within 5 miles of the alternatives have been reserved for mining and drinking water. Surface water rights exist for the City of Shungnak and a private entity, and 2 mining corporations (Ambler Metals LLC and Valhalla Metals AK, Inc.) hold multiple temporary water use authorizations for minerals exploration and camp use. ADF&G has an instream flow reservation of water appropriation for the Middle Fork Koyukuk River approximately 0.8 miles from Alternatives A and B; the reservation of water appropriation is upstream of the proposed Koyokuk River crossing within the GAAR wilderness area and not anticipated to be impacted by project activities. See Appendix D, Table 16, for ADNR-listed surface and subsurface water uses.

The USACE has authority over navigable waters in Alaska that are regulated under Section 10 of the Rivers and Harbors Act. According to the USACE in its capacity as a cooperating agency for this Supplemental EIS, as of October 19, 1995, the USACE Alaska District had identified 4 rivers meeting the definition of navigability that could be affected by the project: the John River from its confluence with the

[12] Because of the distance of the alignments from these waters, the BLM determined that the lack of data was not relevant to understanding reasonably foreseeable significant adverse impacts and that this data was not essential to making a reasoned choice among alternatives.

Koyukuk for 105 miles upstream, the Kobuk River from the Chukchi Sea upstream for 200 miles, the Koyukuk River from its confluence with the Yukon River upstream for 544 miles, and the Yukon River for its entire length of 1,432 miles in Alaska. None of these river segments within the project area is subject to tidal influence.

The Seventeenth USCG District also makes navigability determinations to determine its jurisdiction on specific waterways or portions of waterways in Alaska. These determinations are subject to change or modification pursuant to 33 CFR 2.45. Under Section II, Internal Waters Determined to be Navigable Waters of the United States, the list represents waterways for which the USCG has made a navigability determination. Omission of a waterway from this list does not mean the waterway is not navigable, just that no determination has been requested. This list includes the entire length of the Dietrich River (a tributary to the Middle Fork of the Koyukuk River), the Kobuk River from its mouth to the Village of Kobuk, and the entire length of the Yukon River in Alaska. Boats are known to use many rivers and streams in the project area. Section 3.4.2, Transportation and Access, and Section 3.4.3, Recreation and Tourism, discuss some of these uses.

Flooding and Hydrology

Records of discharge and stage as well as precipitation in the project area are limited. Flooding can be the result of snowmelt in years with high snowfall and accumulation of snow water equivalent in the catchment in late spring, ice jams during breakup (frequent in the area), or excessive rainfall during summer. Generally, maximum discharge occurs during spring breakup, which usually happens during the latter part of May south of the Brooks Range (BLM 2016a). Flooding due to ice jams could become more significant if temperatures increase rapidly and remain elevated throughout spring (MBI et al. 2022).

Gage records for Jim River near Bettles indicate that peak flows occurred during the typical spring breakup period and fall rainstorms. Studies estimated the Koyukuk River at Hughes reached a discharge of 330,000 cubic feet per second during a flood event resulting from 2 high-precipitation events approximately 1 week apart in August 1994 (Kane et al. 2015). This event resulted in floods in Allakaket, Alatna, and Hughes that Kane et al. (2015) estimated to be 100-year runoff events. Many river basins within the project area likely have similar hydrology. Flows in the larger rivers are usually at a minimum in March and maximum in June, July, or August, and winter flows are generally about 20 percent of peak summer flows (BLM 2016a). The south-flowing rivers originating in the Brooks Range likely experience flooding from snowmelt and ice jamming more than from large rainfall events. These rivers would be expected to experience overbank flows during breakup each year, especially at locations where ice jams impede conveyance. The wide river valleys with lower slopes, such as the Lower Koyukuk, Kanuti, and Lower Kobuk, drain a considerably larger area and may experience more summer flooding than snowmelt or ice jam flooding.

Subsurface Water (Groundwater)

Like most areas underlain by permafrost, groundwater is mainly contained within the thaw bulbs of rivers and lakes. Mountainous and steep river reaches tend to have braided channel systems with potential for water transport within the bed or gravel substrate. These systems are more likely to develop aufeis when local geologic features or springs result in water pushing to the surface during extreme cold periods or during increasing subsurface discharge. Increased aufeis development could occur when the ground is disturbed, especially in instances where groundwater or intra-streambed water flow is restricted. Studies have reported no significant aufeis accumulations (lasting into summer); the lack of late spring/summer imagery precludes identification of likely areas where formation is possible[13]. Thaw bulbs could become

[13] The BLM determined there is sufficient information to make a reasoned choice among alternatives. Obtaining additional detailed imagery for a project area of this size would be exorbitant.

extensive in lowland river valleys characterized by meandering channels. Groundwater sources may be considerable, especially in areas where the mean average ground temperature is near 32°F (see Volume 4, Map 3-1). It has been noted that snow and ice fields on the south side of the Brooks Range feed important springs that emerge on the north side of the Brooks Range within the Arctic NWR (Yoshikawa et al. 2007; Kane et al. 2013).

The ADNR Division of Mining, Land, and Water maintains a list of water rights and temporary use authorizations for subsurface and surface sources. Within approximately 5 miles of the project alternatives, there are 8 subsurface water use permits, certificates, and pending actions, including the City of Hughes, City of Kobuk, and several private uses. With 1 exception, the public and private drinking water supplies provided by drilled wells are at least 1.6 miles from the nearest alignment alternative and should be unaffected by potential roadway spills. An Alyeska Pipeline Services well at the 5 Mile Camp supporting Pump Station 6 is 0.5 mile from Alternative C. The 5 Mile Camp well is 275 feet deep and taking water from an artesian aquifer; the depth of the aquifer and artesian pressure of the aquifer makes it unlikely that a surface spill would impact the water quality despite the proximity of the road to the well. The City of Kobuk well, however, is likely influenced by the water quality of the Kobuk River. While located 1.6 miles upstream of Alternative C, it is also downstream of Alternatives A and B and could be impacted by spills on those alternatives. The public drinking water supply for the City of Shungnak is a surface water supply from the Kobuk River and would be more affected by spills near the Kobuk River. This supply is 5.2 miles (approximately 10 river miles) downstream from Alternative C. Ambler Metals LLC has a temporary water use authorization for 2 wells supporting camp activities and mineral exploration at the Bornite Project; the wells are 0.2 and 0.3 mile downstream of Alternative C and could potentially be impacted by roadway spills. This analysis has not identified specific areas of snow collection for water supply/sources for villages.

Water Quality

Limited water quality information is available, other than measurements made at the water monitoring stations described in Appendix D, Tables 8, 9, and 11. However, the majority of streams and lakes within the project area are undisturbed and have little to no human-caused impacts on water quantity, water quality, riparian function, or stream stability. Except for elevated sediment levels in summer due to glacial melting, water quality is generally good to excellent (BLM 2016a). For these reasons, the BLM determined the lack of data was not relevant to understanding reasonably foreseeable significant adverse impacts and this data was not essential to making a reasoned choice among alternatives. Due to climatic conditions, surface water and soils are frozen in winter, limiting pollution inputs into streams. Where surface-disturbing activities are or have been occurring, streams experience elevated turbidity during spring snowmelt and rainfall events. The ADEC Division of Water maintains a list of impaired waters; none of the waters within the project area appear on that list.

Environmental Consequences

Road Impacts

Water resources evaluated in this section include rivers, streams, lakes, and groundwater both in terms of quantity and quality. Additionally, this section includes analysis of key concerns raised by Tribes during G2G regarding water quality and availability, including pollution from hazardous materials, increased slumping into the river from permafrost melt, and contamination of drinking water. The analysis of impacts is based on available data for the water resources within the study area and the proposed Ambler Road conceptual design plans. This section also describes measures that could be implemented to avoid or reduce potential impacts on water resources.

Components and actions of the alternatives that have the potential to affect water resources during construction and operations include gravel mining; placement of gravel fill for infrastructure (e.g., road, access roads, pads, airstrips), placement of ice roads and ice pads during initial roadway construction (Phase 1 Pioneer Road), installation of culverts and bridges, extraction of water supply from local lakes or rivers (for construction of ice roads and ice pads, construction of roadway embankment, potable water use, and dust suppression), and wastewater discharge. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Potential impacts on water quantity and quality would include the following: blockage or convergence of natural drainage (overland flow); changes in stage and velocity of water flow; changes in channel/bank erosion and deposition (scour/sedimentation); increased turbidity during construction and operations; increased potential for overbank flooding; increased potential of aufeis formation; changes in groundwater flow; changes in the soil thermal regime and permafrost; hydrocarbon, mineral concentrate, or other spills; acidification of surface water from exposure to ARD at road cuts; NOA released from gravel extraction or runoff from roadway gravels; fugitive releases of metals, oils, brake, and tire components from haul trucks; and the demand for water supply.

Impacts were evaluated qualitatively and include an evaluation of potential temporary and long-term impacts on water resources for the construction and operation of the Ambler Road. Many of the impacts on water resources quantity and quality resulting from construction of any action alternative would be similar to impacts anticipated during the operations phase of that alternative and during road closure and reclamation. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, describes design features proposed by AIDEA to minimize or mitigate these potential impacts. The proposed project design uses minor culverts at small rills, ephemeral channels, and concentrated drainage pathways to maintain existing drainage patterns and hydrology; however, impacts to natural hydrology would remain. Dispersed overland flow would be concentrated into distinct flow channels leading to the culverts. Changes in water depth and velocity could still result in changes in erosion or sedimentation, ponding, or channel migration. Additional culverts would be included during the detailed design process if needed to adequately capture and convey existing drainage pathways.

AIDEA's commitments in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, state that culverts would be sized to match or exceed existing bankfull widths to maintain existing flow depths and velocities at typical flows and would be sized to have adequate hydraulic capacity to convey flood flows. Bankfull widths would be established based on physical bankfull indicators observed in the field using industry-accepted procedures, such as contained in Rosgen (1996). Common bankfull indicators include slope breaks of banks, the presence of floodplains, the point of incipient flooding/overtopping, depositional features, changes in substrate particle sizes, evidence of inundation features, staining of rocks, the presence and age of certain riparian vegetation species, and exposed root hairs below intact soil layers. Riprap or other erosion control methods would be used to reduce potential for erosion or sedimentation during flood flows. Drainage design would be reviewed by appropriate regulatory agencies (USACE, ADNR, ADF&G) during permitting for the project. Appendix N, Section 3.2.5 (Water Resources) provides potential BLM mitigation measures intended to further minimize impacts on water resources, and other stipulations and best management practices (BMPs).

No Action Alternative Impacts

The road would not be built and there would not be impacts on the water resources associated with AIDEA's proposal under the No Action Alternative. Water resources would be affected by changing climate and permafrost conditions (see Sections 3.2.1, Geology and Soils, and Section 3.2.7, Air Quality and Climate) and other reasonably foreseeable future actions, as described in Appendix H. Continuation

of established small-scale mining development and ore exportation would likely generate similar air traffic and Dalton Highway traffic levels as today, with similar potential impacts to water resources as exist today. Existing mine development is supported through airstrips near mine locations or established specifically for mining activities (see Appendix H, Section 2.1.3, Past Mineral Exploration and Development Potential). Potential increased development activities, expansion of existing mines, and exploration and development of new mining prospects may increase air traffic and Dalton Highway traffic levels, with proportionally increased potential impacts to water resources. As described in Appendix H (Section 2.3.3), there is also potential for the continued lack of surface access to the District to reduce future interests in mineral exploration and associated air traffic. Decreased air traffic would cause proportionally decreased potential for impacts to water resources.

Impacts Common to All Action Alternatives

The impacts are described as a result of specific components or actions taken in the construction and operation of the proposed road. Most actions span both construction and operations and also have multiple impacts on water resources. Appendix E, Tables 11 through 14, quantifies wetland impacts, and Appendix E, Table 16, summarizes impacts to fish stream habitat. These tables help to define the likelihood and magnitude of impact to water resources. In the paragraphs that follow, construction impacts are generally of 2 years per construction phase, while some changes to area hydrology could be long-term or permanent. Impacts associated with traffic would be long-term operational impacts.

The requirements of the ADEC Construction General Permit (CGP) describe control measures that must be used to manage stormwater runoff during construction activities to reduce or eliminate erosion and the discharge of pollutants, such as sediment carried in stormwater runoff from construction sites. If these measures were not implemented properly, polluted stormwater runoff could adversely impact fish, animals, plants, and humans. The permit ensures protection of water quality and human health. The Stormwater Pollution Prevention Plan (SWPPP) is part of the CGP and describes control measures and BMPs that would be used during construction and operation to minimize erosion; protect water bodies; control dust; and address dewatering, soil stabilization, treatment chemicals, fueling areas, spill notification, and inspections. The CGP and SWPPP would control activities associated with gravel extraction, placement of fill, and construction of bridges and culverts as well as maintenance operations. Special condition number 21 of the USACE CWA Section 404 permit establishes requirements for ground-disturbing activities, including stabilization of disturbed areas immediately after construction, revegetation as soon as site conditions allow, stockpile and reuse of native vegetation and topsoil for site rehabilitation, preference of use of native salvaged topsoil, and preference for use of native plant species (USACE 2020).

Gravel for construction of the roadway embankment, airstrips, access roads, and pads, plus for annual maintenance operations, would be extracted from identified material sites along each alternative route (see Volume 4, Maps 2-3 and 2-4, for locations of proposed material sources for the action alternatives and general extent of impact; compare with Volume 4, Maps 3-5 and 3-6, for water resources context). Proposed material sites are located in a variety of terrains, including ridge, upland, and floodplain areas (see Appendix C, Table 2). AIDEA specified in its comments on the Draft EIS that it would model floodplains to allow material site boundaries to be modified to avoid impacts to active floodplains and reduce the likelihood of gravel extraction to impact aquatic habitat. AIDEA anticipates material sites identified near streams and rivers would be developed in upland terraces or abandoned floodplains above the elevation of the active floodplain.

A proposed BLM mitigation measure (see Appendix N, Section 3.2.2) would prohibit mining within the beds of active streams, active floodplains, lakeshores, or outlets of lakes of non-navigable waterways

(State of Alaska owns the submerged lands of navigable waters, and would make gravel extraction permitting decisions if requests for gravel occurred in these areas). Special conditions number 18 and 19 of the USACE CWA Section 404 permit require that floodplains be avoided where practicable; floodplain disturbances be minimized; floodplain function be maintained; and the 100-year flood be conveyed for all bridges and culverts larger than 3 feet in diameter (USACE 2020). If these identification efforts and mitigation measures were not implemented properly, removal of gravel from areas near streams, including floodplains, could result in changes to groundwater level and flow patterns, which is particularly important in fish spawning and rearing stream habitat. In addition, gravel material sites in the active floodplain would also have the potential to be flooded during snowmelt or high-flow events, risking breaching of the material site into the stream corridor and resulting in increased sediment flow into the stream. If active floodplains of meandering streams are not avoided for material sites, the stream's migration over time may also breach the gravel mine site. This could result in increased sediment introduction into the watercourse, changes in streambed characteristics, and degradation of fish habitat.

Most potential material sites are underlain by permafrost and development of the site, and removal of surface vegetation, may result in local permafrost thaw or thermokarsting, especially if the mine site is filled with snowmelt/floodwater. Gravel mining would create some localized dust that could be carried to water bodies and downstream. As noted above, material sites would be required to meet permitting requirements, including a SWPPP, to reduce impacts from dust and other potential contaminants on nearby water quality. Following reclamation, gravel mines may function like a natural lake, but would remain a risk to the natural stream habitat if breached due to bank failure or channel meandering.

The construction of the gravel road and its associated infrastructure would compact underlying soil, potentially impact thaw depths, and reduce natural infiltration into areas below the gravel footprint, all of which could alter the shallow groundwater movement in the active layer. Groundwater flow beneath roadway embankments may increase the thaw of permafrost (Darrow et al. 2013); therefore, AIDEA proposes engineering design measures for flow beneath/through embankments (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, for design features). The gravel roadway embankment is proposed to be 3 to 8 feet thick, which provides additional insulation to underlying soils with the potential to reduce the active layer thickness. The gravel material, however, absorbs more solar radiation than the natural vegetation and could lead to increased permafrost thaw, especially on the south face of east-west roadway alignments.

Placement of gravel fill could also cause changes in the patterns of natural surface drainage, leading to creation of new pathways or changes to existing drainage patterns. AIDEA's design features to minimize permafrost impacts are presented in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA. Special condition numbers 13, 14, and 15 of the USACE CWA Section 404 permit provide mitigation measures to prevent thaw-sensitive permafrost soils, including construction of the road directly to Phase 2 standard embankment depths in area with thaw-sensitive permafrost soils or emergent wetlands, avoidance of the collection of upstream runoff in ditches that would act as heat sinks, and the use of insulation in the roadway as determined necessary from geotechnical investigations and identified prior to construction (USACE 2020).

Increased landslide activity can be caused by permafrost thaw. Permafrost thaw can be caused by the warming climate, heavy precipitation events, and disturbance of the vegetation and surface soil, among others (Lader et al. 2023). This can cause mass movement of material on slopes and exposure of bare soils that can lead to erosion of soil into streams. The potential addition of sediment into waterways could change the water levels and flow paths of impacted waters. This could result in changes to the characteristics of streambeds and further impacts to fish habitats. In addition to the changes to flow paths

and fish habitats, permafrost thaw due to climactic changes presents a challenge to the construction of new infrastructure (Lader et al. 2023). Slopes can become destabilized due to transverse and longitudinal cracks that allow entry of water and deeper thaw penetration and loss of strength due to the general loss of vegetation cover. A variety of new slope failures are possible, particularly in mountainous regions, because permafrost thaw can reduce material strength directly, and indirectly by allowing the entry of water (Swanson, 2021).

Locally, reduced groundwater flow and interrupted surface drainage could result in areas of pooling on the uphill side of the embankment and drying of soils on the downslope side. Pooling would result in greater thermal absorption in summer, accelerating permafrost thaw and potential thermokarsting. Aufeis forms at locations where groundwater or stream flow is forced to the surface and freezes, such as upslope ditches and culverts when the active layer at the roadway freezes quicker than the upslope soils, pushing groundwater to the surface. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, describes AIDEA's design features to minimize interruptions to shallow groundwater flow beneath the roadway embankment and measures to reduce pooling on the upslope side of the embankment. Drying may reduce the vegetative cover, allowing increased solar absorption and permafrost thaw. The changes in surface and groundwater flow may result in increases or decreases in local stream flow and potential changes in timing of lake and wetland recharge. Soils on road embankments are more susceptible to erosion during snowmelt and rainfall runoff than vegetated areas, leading to increased turbidity of receiving waters.

Permafrost thaw impacts peatland hydrology. This can lead to increased generation of runoff, a relative drying of bogs and fens, and an increase in groundwater connectivity. It alters patterns of inundation and wetness and influences magnitude and dominant pathways for peatland runoff. These changes can have significant impacts to overall landscape water storage by enabling groundwater recharge, lake drainage, and increased groundwater discharge in lower landscape positions. This can also lead to increased stream flow during base flow periods. Changes in runoff magnitudes and pathways can affect downstream water quality. This is due to larger interactions between recently thawed peat soils and surface water and increased groundwater connectivity. Increased hydrological interaction with recently thawed peat deposits may increase the concentration and downstream export of dissolved organic matter and methyl mercury (Olefeldt et al. 2021). These changes can alter vegetation composition, impact downstream water quality, timing and magnitude of runoff, habitats for birds and larger mammals, traditional land use, and the exchange of GHGs. The USGS has begun researching color change and associated water quality impacts in Arctic Alaskan streams and rivers draining permafrost landscapes, with orange coloration suggesting iron and carbon mobilization resulting from permafrost thaw. Preliminary observations indicate orange stream reaches are transporting high iron concentrations in dissolved and colloidal form released from thawing soils; these high-iron streams also tend to have less dissolved oxygen and more acidic water compared to nearby clearwater streams (USGS 2022).

During embankment construction, the disturbance of natural soils and dust from gravel placement would be increased, and dust would be deposited on snow and ice during the winter or on vegetation and open water during the summer. The sediments and dust could be introduced into waterbodies when melting occurs, causing an increase in turbidity. Special condition number 22 of the USACE CWA Section 404 permit requires dust abatement practices be performed for the life of the project to minimize road gravel spray and fine airborne dust discharges to the extent practicable (USACE 2020). Construction impacts on water quality would be limited to entrainment of fine-grained fill material in runoff during snowmelt and rainfall events in summer, following construction. Changes in the configuration of the roadway embankment (Phase 1 to Phase 2 to Phase 3) would also increase construction type impacts of gravel placement. The initial construction would be expected to last about 2 years and likely would be continuous with Phase 2 (Phases 1 and 2 total would be 4 years). The construction of Phase 3 would take another 2 years approximately 10 to 12 years later. These estimates are based on the timing and duration

of construction activities estimated in Appendix H, Table 2-9. Under the combined phasing option, as discussed in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, construction is expected to take approximately 2 to 3 years (construction would proceed directly to Phase 2 standards without a defined Phase 1). Special conditions number 2, 3, and 4 of the USACE CWA Section 404 permit provide protections to waters of the U.S. from fill discharges by requiring use of clean fill material, installation of erosion control measures, and that snow and ice clearing operations not result in discharges outside authorized fill areas (USACE 2020).

AIDEA has proposed design features meant to retain cross drainage, so that the gravel road embankment would not unduly affect drainage patterns (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Long-term effects of the gravel infrastructure over the life of the road could include potential changes to the existing hydrologic regime, although this is expected to be largely mitigated with properly placed culverts and bridges, that can accommodate fish passages as necessary (ADF&G 2021), at defined waterway crossings and regularly placed cross-drainage culverts, as outlined in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA. Special conditions number 5, 6, 7, 8, 9, 10, 11, and 12 of the USACE CWA Section 404 permit provide mitigation measures to minimize impacts to streams, floodplains, and fish habitat. Special condition number 5 requires fish passage culverts to meet the 2013 Washington Department of Fish and Wildlife's Water Crossing Design Guidelines, including the requirement that culvert widths shall be 1.2 times the bankfull width of the stream plus 2 feet; this requirement creates a built-in 20 percent margin of safety in meeting the commitment to size culverts to match or exceed bankfull width (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Special condition number 6 requires drainage culvert locations should be determined and staked in the field during breakup. Special condition number 7 requires the implementation of conservation measures outlined in the National Marine Fisheries Service (NMFS) February 21, 2020, letter to the BLM. Special conditions number 8 and 9 require the preservation of floodplain connectivity at stream crossings and the use of overflow culverts to maintain floodplain flow patterns. Special condition number 10 requires a 500-foot buffer around streams in which gravel and other construction materials should not be mined. Special condition number 11 requires a 100-foot undisturbed vegetation buffer should be maintained along ponds, lakes, creeks, rivers, and high-value wetlands, where practicable. Special condition number 12 requires the development of an Adaptive Management Plan for monitoring, maintaining, and repairing culverts over the life of the road (USACE 2020). If these measures were not implemented properly, the gravel infrastructure would result in an increase in sedimentation and turbidity in nearby waterways because of erosion of the embankment materials. Water quality could be affected by the long-term accumulation of road dust during operations. While dust deposited directly into water sources may cause minor impacts, the dust that builds up over time on tundra or floodplain vegetation may cause a larger impact on water quality. During a rain event, accumulated dust could be washed into nearby waterbodies over a short period and increase turbidity, total suspended solids, and other pollutant concentrations depending on the makeup of the source material (see discussions of NOA in local minerals in Sections 3.2.1, Geology and Soils; 3.2.2, Sand and Gravel Resources; and 3.4.5, Socioeconomics and Communities; see also NewFields 2019). Metals can come from natural gravel materials, material transported on the road, and vehicles (e.g., exhaust and brake wear); metals can also become entrained in dust and stormwater runoff (see Sections 3.3.1, Vegetation and Wetlands, and 3.3.2, Fish and Aquatics, for a discussion of impacts on these resources from metals). Special condition number 23 of the USACE CWA Section 404 permit requires that dust suppressants with ingredients potentially harmful to aquatic organisms not be used within 328 feet (100 meters) of any fish-bearing stream or higher value wetlands to reduce the likelihood of contaminants entering waterbodies because of dust control activities (USACE 2020).

Dissolved oxygen concentrations could be affected by increased turbidity. These increases in turbidity are similar to those that occur during high-flow events when sediments that have been deposited on bars and

shorelines over time during low-flow conditions are suddenly mobilized and transported downstream. The gravel infrastructure may accelerate the thawing of permafrost, exposing previously frozen materials to subsurface flows, which may react with constituents of minerals in the soil that had once been sequestered in ice (Barker et al. 2014; Jones 2016). This may mobilize minerals and metals and introduce chemical changes in the soils, groundwater, and surface waters.

Changes in road grade, vegetation clearing, plowed snow banks, guard rails, and bridge abutments change wind patterns, which in turn change snow accumulation and drifting patterns (NCHRP 2019: Section 3.10). Gravel fill from the roadway embankment would also change snow accumulation patterns, which, in turn, could change drainage patterns once the snow melts and increase inundation (flooding) or drying of study areas. Snow drifting could also result in insulation of the surface soils, reducing the freezing of surface soils (active layer) and potentially increasing the depth of permafrost thaw. While plowing of snow from the roadway shoulders and embankment slopes as a mitigation measure to facilitate dissipation of heat out of the embankment may reduce the likelihood of permafrost degradation, it may result in changes in snow accumulation at the base of the embankment (Regehr et al. 2013). This could result in increased insulation of the embankment as well as the possibility of road dust, deicing agents, contaminated road sands and other road surface materials reaching further into the surrounding environment during snowmelt runoff. Increased inundation from melting snow accumulations could increase areas of pooling and thermokarst action, creating settlement, impounded areas of water, and increased permafrost thaw.

To construct the road in 4 years or less, as discussed in Section 2.4, Alternatives Retained for Detailed Analysis, whether under phased construction or the combined phasing option, AIDEA proposes to construct the road from multiple construction camps staged along the road corridor. AIDEA also proposes to complete bridge construction and progress initial road construction during winter. To facilitate the planned construction, winter construction access trails would be necessary to mobilize equipment, materials, supplies, and personnel to construction camps and proposed material sites along the road corridor. As such, ice roads, ice pads, and ice bridges are anticipated to be a necessary winter construction technique. Ice pads may be constructed to support gravel mine extraction activities, for staging equipment and supplies during construction, and for work platforms for bridge construction. River crossings and wetland area ice covers in some areas would likely be thickened to provide bearing capacity for heavy construction vehicles during initial pioneer road construction. Ice roads and pads could locally change snow accumulation patterns and may damage underlying vegetation. Ice roads in Alaska typically require approximately 1 million gallons of water for each mile of a 25-foot-wide ice road; however, individual road segments are not anticipated to be even 1 mile long. Approximately 250,000 gallons would be required per acre of ice pad. As discussed below, water necessary for construction of ice roads and pads would be withdrawn from lakes or large rivers near the construction activities as allowed by State of Alaska temporary water use authorizations and fish habitat permits.

During spring breakup, ice road segments across floodplains and ice pads could temporarily block sheet flow within drainages, altering the natural distribution of surface waters. Until ice roads melt, shallow groundwater and sheet flow may build up on the upslope side, potentially increasing permafrost thaw. To ensure adequate drainage at stream crossings, ice roads would be removed, slotted, or scored prior to spring breakup to avoid increased erosion of streambanks upstream and downstream of the crossing. Meltwater from ice roads and pads during spring breakup could have a temporary localized effect on specific conductance, alkalinity, and pH in the surrounding waterbodies. Spills or material releases (e.g., lubricants, oils, fluids) on ice roads or pads would be required to be removed prior to melt out as per appropriate BMPs.

The proposed project alternatives would require a large number of bridges and culverts as defined in Appendix D, Table 17 (see DOWL 2016a: Appendix 5C, Maps 6 through 14, for diagrams showing typical culverts and bridges). The table helps to define the likelihood and magnitude of impact. All of the action alternatives have a similar number of stream crossings and estimated hydraulic cross-connection culverts, ranging from 13.85/ mi (Alternative C) to 14.05/mile (Alternative B). Special condition number 19 of the USACE CWA Section 404 permit requires that a 100-year flood be conveyed for all bridges and culverts larger than 3 feet in diameter (USACE 2020). Typical DOT&PF design parameters for highways in Alaska require that bridges must convey the 100-year flood and culverts must convey the 50-year flood, so the USACE design requirements are consistent with DOT&PF design parameters for bridges and more conservative than DOT&PF design parameters for culverts. The engineer of record for the final design of culverts and bridges will be responsible for completing hydrologic and hydraulic calculations showing that the proposed structures as designed are of sufficient size to convey the 100-year flood in accordance with permit stipulations. The engineer of record for the final design of culvert and bridges will also be responsible for determining appropriate hydrologic methodologies in consideration of the 50-year design life of the structures to account for increasing extreme weather events and the effects of climate change on the hydrologic regime. Regulatory agencies responsible for issuing new or revised permits authorizing construction of designed culverts and bridges, such as the USACE and ADF&G, will be responsible for ensuring hydrologic methodologies used are appropriate based on available current science and literature. Additionally, typical sections included in the SF299 permit application indicate that bridges and culverts would be armored with riprap expected to be stable during flood events. As such, the USACE-required design parameters are expected to reasonably account for and protect structures from flood events, including climate-change-induced extreme weather events. While periodic O&M activities would be required over the 50-year design life of the road, anticipated O&M efforts can be expected to be at comparable levels to other bridges within Alaska's highway network.

Bridges have the potential to impact flow velocities and depths, especially during high-flow events, freeze-up and breakup ice runs, and ice jams. Bridges for this project are defined as small (less than 50-foot span), medium (50- to 140-foot span), and large (multiple spans of up to 140 feet with sets of piers within the river channel). AIDEA has proposed that bridges would be designed to pass a 100-year flood event with limited impact to the floodplain, minimal increase in water levels upstream of the bridge, and nominal changes in water velocity through the bridge opening (DOWL 2016a). Abutments are proposed to be designed outside of the full channel width and would be protected from erosion by riprap or other appropriate scour protection. Large bridges would include piers within the river channel, which have a local impact on water velocity and bed scour around the piers during flood events. The piers should be located to lessen impacts on fish and boat passage while maintaining sufficient protection from scour in the event of channel shifting. Construction of piers in the river channels may impact water quality by disturbing substrate and temporarily increasing suspended solids. Construction of the bridges is proposed to be primarily during winter to reduce the potential for substrate entrainment and elevated suspended solids by completing work during what are typically the lowest flow conditions.

Consideration of boat passage is a USCG requirement for bridges on rivers the USCG has determined are navigable waters, and they would need to be designed to maintain a bottom chord clearance sufficient for boat passage. Boat size is likely to vary considerably depending on the water body, from canoes and rafts to loaded barges. Additionally, special condition number 24 of the USACE CWA Section 404 permit requires that the road "not interfere with the public's right to free navigation on all navigable waters of the U.S." (USACE 2020). AIDEA has proposed that the bridges would be designed to allow continued navigation; see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA. During consultation with the USCG, AIDEA submitted a revised Table 2 – Section F to the SF299 USCG Bridge Permit Application that committed to providing a minimum of 12 feet of vertical clearance for the 11 large bridges along Alternative A (Koyukuk, Wild, John, Malamute Fork Alatna, Alatna, Kobuk, Reed,

Mauneluk, Kogoluktuk, and Shungnak rivers and Beaver Creek). On December 18, 2020, the USCG issued 2 letters to AIDEA regarding proposed bridge construction along Alternative A, and thus assumed generally applicable to Alternative B. The first letter granted advanced approval for the Koyokuk River bridge under 33 CFR 115.70 and states that a USCG bridge permit is not required for the proposed bridge. The second letter states that the remaining proposed crossings "are not tidally influenced and are not currently used for substantial commercial navigation," so the USCG declines jurisdiction and USCG bridge permits are not required for the proposed bridges. No USCG determination has been completed for Alternative C.

There is the potential for AIDEA to use a variety of methods to install steel or concrete bridge piers or abutment pilings into the earth. Some techniques use drilling fluids (drilling muds) to provide cooling to the drilling bit, provide stability to uncased borings, and facilitate moving cuttings to the surface. If used, there is the potential for this material, composed primarily of a combination of water, bentonite, and barite, to be discharged to the river (even in winter). If discharged, this material would increase turbidity and potentially deposit on the streambed in areas of low velocity, and could release toxins in the drilling mud or in the native material, affecting fish habitat. As noted in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, construction of bridge piers and abutments would be completed under an ADEC-regulated SWPPP and under ADF&G fish habitat permits and the USACE permit (as applicable) to minimize impacts on water quality and to aquatic species. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N also describe commitments related to in-water construction and the potential use and disposal of drilling muds.

Culverts would be installed at defined drainages to maintain drainage patterns and connectivity of wetlands and other surface waterbodies and facilitate floodplain connectivity. Culverts for this project are defined as major (11 to 20 feet in diameter), moderate (4 to 10 feet in diameter) and minor (3 feet in diameter) (see DOWL 2016a: Appendix 5C, Maps 6 through 14, for diagrams showing typical culverts and bridges). Major and moderate culverts would be embedded using stream simulation and natural channel design practices providing a span meeting or exceeding the bankfull width of the natural channel where necessary for fish passage. Bankfull width would be determined through observation of physical bankfull indicators at or near the proposed crossing locations. AIDEA intends to provide fish passage at all perennial and well-established ephemeral stream crossings during Phase 1 or combined phasing construction. Flow constrictions and increased stream velocity may occur at the inlet and outlet of a culvert on a defined channel, which could lead to increased depths upstream of the culvert and potential streambed scour and bank erosion at the culvert outlet, with sediment deposition a short distance downstream of the culvert outlet. Special condition number 20 of the USACE CWA Section 404 permit requires trenches constructed to install culverts or other infrastructure not drain WOTUS, trenches be backfilled to existing elevations and revegetated, and wetlands be protected from the placement of temporary material (USACE 2020).

Culvert design is proposed to include insulation and bedding material beneath the culvert to facilitate groundwater flow at the crossings and to lessen the potential for aufeis formation otherwise resulting from blockage of shallow groundwater flow. Stream banks impacted during construction would be reconstructed and stabilized using bioengineering and/or riprap scour protection to reduce the likelihood of bank erosion during flood events. Riprap protection would also be provided at the inlet and outlet to prevent erosion of the embankment.

Cross-drainage culverts are proposed to be placed in gravel roadways to maintain natural surface drainage patterns. While defined drainage and connectivity culvert placement has been determined by aerial photography and the National Hydrography Dataset (NHD), additional cross-drainage culverts (size, placement, and need for fish passage) would need to be determined based on hydraulic design criteria and

in consultation with regulatory agencies. Final design placement of culverts would need to be field-verified and reviewed with the ADF&G for concurrence during permitting. The estimated spacing of cross-drainage culverts is every 1,000 feet; however, some culverts could be spaced closer than 1,000 feet to mitigate the impacts of sheet flow interruption and thermokarst action. AIDEA has proposed a design feature that cross-culverts in wetland areas without defined water channels be spaced approximately 150 feet apart (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Culverts would be installed during Phase 1 construction at the Phase 2 length required, with additional embankment cover to protect the culverts prior to the construction of the Phase 2 roadway embankment. Additional cross-drainage culverts could be placed after the first spring breakup as site-specific needs are further assessed with regulatory agencies, in combination with field observations of impacts on natural drainage patterns. During Phase 3 construction, the culverts would be extended as needed to accommodate the increased embankment width, which would result in local impacts on water quality by disturbing substrate and temporarily increasing suspended solids. Construction of the culverts in Phase 1 and increasing their length in Phase 3 would result in disruptions to the streambed and banks, and may impact water quality by temporarily increasing suspended solids. The initial construction to install culverts would be expected to last about 2 years, and the construction of Phase 3 would take another 2 years approximately 10 to 12 years later, based on the timing and duration of construction activities estimated in Appendix H, Table 2-9.

Water access points would be located along the routes at rivers and lakes to provide water for construction activities, maintenance (dust control), and potable water supply for maintenance or fueling stations. While the specific locations of water access points have been proposed within GAAR, they have not all been identified outside of GAAR. Some water access points also identify the footprint for access roads leading from the Ambler Road to the water location. Water for construction and maintenance of any ice roads (stream and river crossings) and pads, and domestic use at the construction camps during construction activities would be withdrawn from lakes or large rivers near the construction activities. State of Alaska temporary water use authorizations and fish habitat permits would be required. The permit requirements limit the amount of water that can be withdrawn from these sources. Withdrawals of unfrozen water from lakes during winter would be anticipated to be subject to stipulations and BMPs similar to those for North Slope activities described by the BLM (2013a). If sensitive fish are present in these lakes, water withdrawal is limited to 15 percent of the estimated water volume below 7 feet. In lakes with only non-sensitive fish present, water withdrawal is limited to 30 percent of the estimated water volume below 5 feet. In lakes without fish, water withdrawal is limited to 35 percent of the total lake volume (BLM 2013a).

Water withdrawal at individual permitted lakes is not expected to impact the hydrology other than causing minor fluctuations in water levels during winter. The impacts would decrease as natural lake recharge occurred during spring breakup. Many lakes and wetland areas have surface and subsurface connections with adjacent lakes, whereby water withdrawals from a lake might lower the level of an adjacent lake. This effect would likely be short-lived due to the annual recharge processes from snowmelt during breakup and the high level of interconnectivity of the lakes. Temporary water quality effects from water withdrawals from ice-covered lakes during winter include decreasing dissolved oxygen concentrations and increasing salinity and concentrations of dissolved constituents (e.g., calcium, magnesium, sodium, potassium, calcium); pumping typically doesn't result in a notable change in pH, temperature, or nitrates and sulfates levels (MBI 2002). Dissolved oxygen availability is greatest in the fall when lake ice forms and decreases over the winter until breakup when dissolved oxygen rapidly increases. The initial dissolved oxygen decline during ice formation is more rapid in shallow lakes as compared to deeper lakes and lakes with small littoral areas. The ice cover both isolates the lake from atmospheric effects and reduces photosynthesis, mixing, and heat and gas exchange; thus, restricting oxygen input (Leppi et al. 2016). NPR-A lakes showed a reduction in dissolved oxygen during under-ice pumping, as compared to

reference lakes, that persisted until spring recharge (MBI 2002). Limitations on water withdrawals from ice-covered lakes as discussed in the paragraph above will reduce the impacts on water quality. Water withdrawals may also occur from the larger rivers within the project area but may be limited to ice-free periods as winter flows are very low and access points may be difficult to maintain. Access roads to these water access points would be designed to avoid impacts on the floodplain (e.g., flow blockage, erosion of access pad), as water levels would have a greater variation from base flow to flood stage. See Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, for design features and Appendix N for potential BLM mitigation measures to avoid and minimize impacts.

Construction camps and maintenance stations would generate wastewater from typical domestic operations associated with food preparation and lodging of personnel. The construction camps would have a greater number of people at the camps but would be short duration (1 to 2 years for each construction phase). The maintenance stations would house fewer personnel, but may have a greater incidence of collected materials associated with vehicle maintenance and repair. Impacts of wastewater discharge would depend on the method of disposal. A potential mitigation measure in Appendix N would require the road operator to submit plans for waste management for review and approval by appropriate regulatory agencies; the BLM anticipates these plans would be similar to those at maintenance stations along the Dalton Highway. Wastewater would likely be treated in a small package plant and discharged to a drain field. Solid waste would likely be incinerated and hazardous wastes would likely be trucked off site for proper disposal. Typical wastewater would be discharged through an engineered system that would meet ADEC requirements. Such a system typically would impact shallow groundwater in terms of increased release of warmer water and potential pollutants, including fecal coliform bacteria. Thermal impacts of these systems could also increase thaw of the permafrost, which could result in additional changes to the groundwater flow and potentially damage the system itself through thermokarsting of lagoons or failure of mounded septic systems. As the construction camps would be temporary, the efficiency of the treatment system must be considered in the design. If wastewater effluent is to be discharged to streams, appropriate ADEC permits would be required, which would also address impacts on the stream.

Spills, including fuels, chemicals, and ore concentrates are discussed in Section 3.2.3, Hazardous Waste. Their effects on water quality streams, lakes, and groundwater would be dependent on the type of spill, quantity of material spilled, time of year (frozen ground and surface waters), and the discharge in the receiving water body. Unauthorized road users are discussed in Section 3.4.2, Transportation and Access; unauthorized road users are not anticipated to have significant impacts on water resources but could result in unsafe operational conditions on the road and contribute to localized spills.

Human health hazards from drinking water containing asbestos are considered to be orders of magnitude less hazardous than the potential hazards due to airborne asbestos. The World Health Organization (2003) concluded, "although asbestos is a known human carcinogen by the inhalation route, available epidemiological studies do not support the hypothesis that an increased cancer risk is associated with the ingestion of asbestos in drinking-water." The EPA Drinking Water Standards set 7 million asbestos fibers per liter as the Maximum Contaminant Level for public drinking water. Runoff and fugitive dust washed off vegetation in areas where NOA is used in road construction would increase the concentration of asbestos in water resources. Special conditions number 29 and 30 of the USACE CWA Section 404 permit require that use of materials containing NOA (defined as 0.1 percent asbestos by mass) be avoided to the greatest extent practicable, geotechnical investigations be conducted to identify areas to be avoided due to NOA and sulfide minerals that can cause ARD, and that a final project plan be developed for construction that incorporates all required and proposed mitigation measures (USACE 2020).

Recognizing the unique characteristics of Nutuvukti Lake and the Nutuvukti Fen, special conditions numbers 16 and 17 of the USACE CWA Section 404 permit require that the road be designed to minimize the disruption of surface and shallow groundwater flows through the active layer upstream of the lake and fen to protect hydrologic inputs and that the road alignment be located to minimize water quality impacts to the lake and fen (USACE 2020).

Alternative A Impacts

Alternative A would have the shortest length and footprint area of main and access road embankments. Alternatives A and B have the same number of construction camps, maintenance stations, and airstrips. Alternative A would have the least number of vehicle turnouts and material sites. With the least footprint area of gravel infrastructure (see Appendix C, Tables 1 and 2), Alternative A would be expected to have the least overall impacts associated with blocking surface and groundwater flow, redirecting surface drainage pathways, and increasing permafrost thaw as well as the least amount of increased turbidity associated with gravel placement during embankment construction or road dust washed into streams and rivers.

AIDEA submitted a revised permit application to the USACE in February 2020 for Alternative A. The USACE permit was subsequently issued on April 25, 2020. During coordination with the USACE on the permit application prior to its issuance, AIDEA committed to changing 1 major culvert to a medium bridge; 1 minor culvert, 8 moderate culverts, and 10 major culverts (19 total) to small bridges; and 4 minor culverts to major culverts; these changes are summarized in Appendix F of the 2020 JROD. The revised Alternative A culvert and bridge quantities are listed in Table 1 of Appendix C and Table 17 of Appendix D.

As the shortest alignment, Alternative A would have the fewest number of minor culverts (2,864). It would have 7 moderate culverts and 12 major culverts, which would both be greater than Alternative B. The total number of culverts (2,883) would be the least of all the alternatives, and therefore would be expected to have fewer impacts associated with flow constrictions, such as increased stream velocities at culvert inlets and outlets, increased depths upstream of culverts, potential streambed scour and bank erosion at culvert outlets, and sediment deposition downstream of culvert outlets.

In the absence of specific floodplain data for each waterbody, floodplain area impacts were estimated using the proposed number, size and length of crossing structures. Floodplain impact width was calculated as 3 times the proposed culvert/bridge length, and floodplain impact length extended 5 times the culvert diameter/bridge length upstream and downstream of the crossing structure. The area of floodplain that would be impacted by the roadway embankment, drainage culverts (excluding additional cross drainage culverts), and impacts upstream and downstream of the culverts was estimated to be approximately 81.5 acres, which is the smallest of the alternatives (see Appendix D, Table 17, which helps define the likelihood and magnitude of impacts). There would be 22 small bridges, 16 medium bridges, and 11 large bridges on Alternative A. Analysis indicates that 2,071 acres of floodplain would be affected for bridges in Alternative A (see Appendix D, Table 17).

The impacts of the roadway on water quality were estimated by determining the miles of roadway embankment in a floodplain or within 1,000 feet of a mapped floodplain. For this estimate, the available floodplain vegetation mapping (primarily for large rivers/bridges) was compared to the various alternative alignments. Floodplain mapping for smaller streams does not exist; for this analysis, floodplain impacts from small/medium bridges and minor/moderate/major culverts were estimated as 3 times the culvert diameter or bridge length. For Alternative A, 11.6 miles (5.5 percent) of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams), and a total of 16.1 miles (7.6 percent) are within 1,000 feet of a floodplain (includes the miles in the floodplain; see Appendix D, Table

18). The table helps to define the likelihood and magnitude of impact. These impacts to water quality of the floodplain areas should be considered in conjunction with impacts to wetlands and vegetation, which also affect water quality. Those impacts are discussed in Section 3.3.1, Vegetation and Wetlands, and Appendix E, Tables 8 through 14, and include the direct footprint impacts and dust impacts to different classifications of wetlands along the alternatives, helping to illustrate the magnitude of impact to these water resources.

Alternative A has 3 more medium bridges than Alternative B. Two large bridges pass over different reaches of the Reed and Kobuk rivers for Alternatives A and B, but all other large bridges are the same for these 2 alternatives. The crossing over the Kobuk River (Wild and Scenic River designation) on Alternative A occurs within GAAR. The Kobuk River bridge, with piers in the water and abutments in the floodplain, would affect the free-flowing nature of the river—a quality the WSR designation was designed to protect. Designing the crossing of the Kobuk River as a full span bridge without piers in the water channel is a mitigation measure that would eliminate or reduce impacts to channel migration and the free-flowing sinuosity of the river, as well as reducing impacts to fish habitat (Section 3.3.2, Fish and Aquatics), navigability (see Section 3.4.3, Recreation and Tourism), and subsistence resources (Section 3.4.7, Subsistence Uses and Resources) beyond the park boundaries. The NPS Draft EEA (NPS 2019a) evaluated the impacts of a multi-span bridge, because a full-span bridge was deemed not economically feasible in the conceptual design phase. The NPS has proposed mitigation to minimizing the impact of the bridge design and construction in its Draft EEA (NPS 2019a). See Appendix N for details. The crossings of the Kobuk and Reed rivers on Alternative A are higher up in the basin, and therefore would experience lower discharges and would be further upstream from sheefish spawning habitat on the Kobuk River, farther downstream.

The alignment passes close (0.25 mile) to Lake Nutuvukti within GAAR and could impact water quality from roadway runoff. While the alignment may be within the sight distance of Walker Lake, it is approximately 3 miles away and not within impact distance for water quality.

Alternative B Impacts

Alternative B would be 17 miles longer than Alternative A and would follow the same alignment except for a short portion that travels in the near vicinity of and through GAAR. Since it is longer, it would have a greater number of access road embankment miles, vehicle turnouts, and material sites. Alternative B would have the same number of construction camps, maintenance stations, and airstrips as Alternative A. Alternative B would have a somewhat larger total infrastructure footprint (see Appendix C, Tables 1 and 2, which help to define the likelihood and magnitude of impact), and therefore would be expected to have greater impacts associated with blocking surface and groundwater flow, redirecting surface drainage pathways, increasing permafrost thaw, and a greater amount of increased turbidity associated with gravel placement during construction or road dust washed into streams and rivers compared to Alternative A (see Appendix D, Table 18, which helps to define the likelihood and magnitude of impact).

For the Supplemental EIS analysis, it was assumed that the proposed changes listed in the 2020 USACE permit are applicable to Alternative B for the portion of the alignments where Alternative B overlaps with Alternative A. As a result, the net change for Alternative B is a decrease of 5 minor culverts, a decrease of 7 moderate culverts, a decrease of 3 major culverts, and an increase of 15 small bridges relative to the quantities listed in the Final EIS. Updated culvert and bridge quantities for Alternative B are listed in Table 1 of Appendix C and Table 17 of Appendix D.

Alternative B would have a greater number of minor culverts (3,150) than Alternative A, but would have only 5 moderate and 9 major culverts, which are both less than Alternative A. The total number of culverts (3,164) would be greater than Alternative A since Alternative B is longer overall. Because the

total number of culverts would be greater, Alternative B would be expected to have the greater impacts associated with flow constrictions, increased stream velocity at the culvert inlet and outlet, increased depths upstream of the culvert, potential streambed scour and bank erosion at the culvert outlet, and sediment deposition a short distance downstream of the culvert outlet.

The area of floodplain impacted by the roadway embankment, drainage culverts (excluding additional cross-drainage culverts), and impacts upstream and downstream of the culverts is approximately 86.7 acres, which is greater than under Alternative A. The floodplain impact estimate of the bridges (18 small, 12 medium, and 11 large) indicates that 2,047 acres of floodplain would be affected by the bridges in Alternative B, which is slightly less than, but similar to, Alternative A.

The impacts of the roadway on water quality were estimated by determining the miles of roadway in a floodplain or within 1,000 feet of a mapped floodplain. For this estimate, the available floodplain vegetation mapping (primarily large rivers/bridges) was compared to the various alternative alignments. Floodplain mapping for smaller streams does not exist; for this analysis, floodplain impacts from small/medium bridges and minor/moderate/major culverts were estimated as 3 times the culvert diameter or bridge length. For Alternative B, 12.4 miles (5.4 percent) of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams), and a total of 17.3 miles (7.6 percent) are within 1,000 feet of a floodplain (includes the miles in the floodplain).

As stated above, the number of bridges is the same for Alternatives A and B except for the section where Alternative B loops to the south to reduce the length of roadway within GAAR (approximately 18 miles for Alternative B compared to 26 miles for Alternative A). There are 4 fewer small bridges and 4 fewer medium bridges on Alternative B than on Alternative A. Alternatives A and B both have 11 large bridges.

The Alternative B crossing over the Kobuk River (Wild and Scenic River Designation) is longer than the crossing on Alternative A and occurs along a straight, faster moving section. The Kobuk River bridge, with piers in the water and floodplain, would affect the free-flowing nature of the river—a quality the WSR designation was designed to protect. Designing the crossing of the Kobuk River as a full span bridge without piers in the water channel is a mitigation measure that would eliminate or reduce impacts to channel migration and the free-flowing sinuosity of the river, as well as reducing impacts to fish habitat (see Section 3.3.2, Fish and Aquatics), navigability (see Section 3.4.3, Recreation and Tourism), and subsistence resources (see Section 3.4.7, Subsistence Uses and Resources) beyond the park boundaries. The NPS (2019) evaluated the impacts of a multi-span bridge, because a full-span bridge was deemed not economically feasible in the conceptual design phase. The NPS has proposed mitigation to minimizing the impact of the bridge design and construction in its Draft EEA (NPS 2019a). See Appendix N for details. The crossings of the Kobuk and Reed rivers on Alternative B are lower in the basin than those on Alternative A, and therefore would experience higher discharges and would be closer to sheefish spawning habitat on the Kobuk River farther downstream.

Alternative B would pass within 0.5 mile and upslope of Norutak Lake just outside of GAAR boundary and could be within impact distance for water quality from roadway runoff.

Alternative C Impacts

Alternative C would be longer than Alternatives A and B at 332 miles and would follow an alignment that would traverse along river valleys for a large part of its length. Since it would be the longest of the action alternatives, it would have the greatest number of access road embankment miles, vehicle turnouts, material sites, construction camps, maintenance stations (5), and airstrips (5) compared to Alternative A or B. As such, Alternative C would have a larger total gravel infrastructure footprint (see Appendix C, Tables 1 and 2) and would be expected to have the greatest impact associated with blocking surface and

groundwater flow, redirecting surface drainage pathways, and increasing permafrost thaw as well as the greatest amount of increased turbidity associated with gravel placement during construction or road dust washed into streams and rivers of all of the alternatives (see Appendix D, Table 18, which helps to define the likelihood and magnitude of impact).

Alternative C would have the greatest number of minor culverts (4,076), moderate culverts (131), and major culverts (141)—substantially more than either Alternative A or B. The total number of culverts (4,348) would also be greater than Alternative A or B due to the length, and therefore Alternative C would be expected to have the greatest impacts associated with flow constrictions, increased stream velocity at the culvert inlet and outlet, increased depths upstream of the culvert, potential streambed scour and bank erosion at the culvert outlet, and sediment deposition a short distance downstream of the culvert outlet of any of the action alternatives.

The area of floodplain that would be impacted by the roadway embankment, drainage culverts (excluding additional cross-drainage culverts), and impacts upstream and downstream of the culverts is approximately 181 acres, which would be greater than Alternative A or B. There are 79 small bridges, 158 medium bridges, and 14 large bridges. This number of bridges is much higher than Alternatives A and B. Floodplain analysis indicates that 4,092 acres of floodplain would be affected by the bridges in Alternative C—considerably more than Alternative A or B (see Appendix D, Table 17, which helps to define the likelihood and magnitude of impact).

The impacts of the roadway on water quality were estimated by determining the miles of roadway in or within 1,000 feet of a mapped floodplain. For this estimate, the available floodplain vegetation mapping (primarily large rivers/bridges) was compared to the various alternative alignments. Floodplain mapping for smaller streams does not exist; for this analysis, floodplain impacts from small/medium bridges and minor/moderate/major culverts were estimated as 3 times the culvert diameter or bridge length. For Alternative C, 77.7 miles (23.4 percent) of the roadway alignment would be located in a floodplain (primarily where it crosses rivers and streams) and a total of 96.3 miles (29.0 percent) are estimated to be within 1,000 feet of a floodplain (includes the miles in the floodplain)—much more than Alternative A or B. This is a result of the proposed Alternative C alignment traversing parallel to many of the stream drainage corridors rather than crossing them.

The crossing of the Kobuk River on Alternative C is approximately 1,400 feet wide and is lower in the basin than Alternatives A and B, and therefore would experience higher discharges and would be closer to sheefish spawning habitat on the Kobuk River.

Combined Phasing Option

The combined phasing option has potential to reduce impacts to permafrost and water quality by limiting temporary disturbances, construction staging, and construction activities to a single construction phase (direct to Phase 2 standards). Special condition number 13 of the USACE CWA Section 404 permit specifies, "The permittee shall construct the road to Phase II standard embankment depths in areas with thaw sensitive permafrost soils and in emergent wetlands, without first constructing the pioneer road." Approximately 60 percent of the Alternative A alignment is estimated to be in in areas with thaw-sensitive permafrost soils or emergent wetlands, so the combined phasing option would be directly applicable to the remaining 40 percent of the alignment. Alternatives B and C have similar proportions of around 60/40 percent, as illustrated in Appendix E, Tables 11 through 13, so it is reasonable to assume that the combined phasing option would provide potential benefits for approximately 40 percent of the road alignment for Alternatives B and C, as well. Prior to roadway construction, additional geotechnical investigations would be necessary to refine mapping of "areas with thaw sensitive permafrost soils." The

combined phasing option would extend protections, by way of reduced disturbances, to areas of the road alignment outside coverage of the USACE CWA Section 404 permit, reducing likelihood of permafrost degradation resulting from road construction impacting downstream water quality.

As culverts would be installed to Phase 2 lengths during construction of the Phase 1 pioneer road, impacts to stream channels associated with culvert installation are expected to be similar for both the combined phasing option and phased construction options.

The combined phasing option may result in more potential impacts from ice roads and ice pads, as discussed previously in this section, due to winter construction access trails relative to the phased construction options. Under phased construction options, the Phase 1 pioneer road would be generally complete by the end of year 2, providing full surface access along the road corridor and reducing reliance on winter construction access trails during years 3 and 4 of construction. Under the combined phasing option, full surface access along the alignment would be not feasible until completion of the road to Phase 2 standards at the end of year 3, so construction would rely more heavily on a third season of construction winter access trails to connect road segments along the corridor.

The combined phasing option may result in more temporary disturbances near river and stream crossings associated with staging materials, specifically bridge girders and piles, and equipment that must be transported by truck. The combined phasing option would ultimately construct the same Phase 2 road embankment as would be constructed under phased construction, but construction would proceed more slowly from construction camps relative to Phase 1 pioneer road construction due to the requirement to construct a larger embankment section as construction progresses. This would result in larger sections of the alignment being inaccessible to vehicle access during early construction seasons when the winter construction access trails are not in place. As a result, bridge crossings that may be accessible from construction camp via a Phase 1 pioneer road under phase construction options may be isolated within comparable time frames under the combined phasing option; this may result in a greater need to stage equipment and stockpile materials at bridge crossings so that construction can continue following seasonal closure of the winter construction access trails. Furthermore, bridge girder fabrication can have significant lead times; it is foreseeable that temporary impacts and disturbances at bridge sites may be extended if bridge work is delayed due to the inability to transport all required materials to the site while the winter construction access trails are in place.

Mining, Access, and Other Indirect and Cumulative Impacts

Past actions are those that have resulted in changes to and have given rise to the existing state of the quantity and quality of the water resources of the project area. Those actions include past placer mining occurring both in and outside of river channels; construction of the Dalton Highway and TAPS corridor; transportation developments, including trails, roads, pipelines, and the general increase in use of petroleum-based fuels; consolidation of Native populations into larger hub communities with the establishment of organized schools; improvements in remote community water supply and wastewater treatment; and worldwide increases in CO_2 from the increase in use of fossil fuels, which could contribute to climate changes. In general terms, past actions have mostly had local impacts on water resources with respect to project area stream channel morphology and water quality, but overall water resources are in a fairly pristine state.

Any of the action alternatives for construction and operation of the proposed road would impact surface and groundwater drainage patterns, connectivity, water levels, and velocity. While the impacts would be long term and possibly permanent, they would also be local, associated with the roadway embankment and its crossings. Water quality impacts would be more noticeable, but generally local to the roadway embankment and crossings (erosion, turbidity), except for spills, which have the potential to travel longer

distances downstream. Water quality impacts would be generally episodic, such as rainfall events washing road dust into streams, ice breakup causing local flooding, or spills of hazardous materials. Indirect impacts from mine development would also be local to the mine development sites but could be greater in terms of water quantity (water use), extent of impacts due to changes in drainage patterns, and potential water quality impacts from mine operations. These same types of impacts are likely to occur on the Dalton Highway as the result of mining-related traffic and the day-to-day maintenance and long-term highway upgrades that DOT&PF is likely to deem warranted, in part, as a result of the additional traffic. Alternatives A and B traffic would affect 100 more miles of the Dalton Highway than Alternative C traffic. All alternatives would increase risk of spills in waterways and induce additional maintenance and construction efforts along the Dalton Highway that would affect waterways (e.g., widening or realigning highway curves requiring new culverts or lengthening of existing culverts), but Alternative C would affect 100 fewer miles of existing roadway.

Mining

The greatest indirect and cumulative impacts would arise from potential development of the individual mining prospects. Mine development would include impacts from new mine access road construction in terms of changed surface and groundwater flow patterns, establishment of large infrastructure pads, and removal of vegetation and overburden soils. In addition, hard rock mining often involves moving massive amounts of rock (open pit), which disrupts the natural surface and groundwater interaction and requires removal of water from the mine to be stored in tailings ponds for reuse and treatment. Large excavations would likely intercept the groundwater table, resulting in increased aufeis formation. Placer mining operations could result in extensive changes to channel alignment, bed and bank configuration, stream habitat, and floodplain geometry and function in addition to water quality, turbidity, and aufeis formation.

Water supply and usage for the mining of rock, processing of ore, and maintenance of facilities, combined with potable water requirements, would be expected to have an impact on water quantity and water quality of rivers and lakes. Groundwater levels and permafrost within mined areas would be permanently disrupted. Impacts on water resources quality may include increased dust from mining operations, potential spills and containment of ore concentrates, chemicals used in processing ore, fuels, and process water, in addition to wastewater from operations of facilities and camps, and may require treatment of mine water in perpetuity (Hughes et al. 2016; Limpinsel et al. 2017; Woody et al. 2010). A study of water quality compliance found that while all mines reviewed predicted compliance with water quality standards, 76 percent exceeded water quality pollution limits as a result of mining (Kuipers et al. 2006). Adverse impacts to water quality were found to be common at mine sites and most often caused by failed mitigation (Kuipers et al. 2006; Maest et al. 2005; Woody et al. 2010). If discharged water did not meet intended water quality standards, impacts to the health of fish, birds, and other animals and to humans using the water could occur, as described in other sections of Chapter 3 and in Appendix H of this Supplemental EIS. Groundwater levels and permafrost within mined areas would be permanently disrupted.

Standard mine operations, including some typical measures for mine water use and treatment, are described in Appendix H, Section 2.1.4, Reasonably Foreseeable Mine Development Scenario, Mine Water Management and Water Supply). Impacts of water needs and use from the mine facilities would be similar to those of construction camps and maintenance stations, except for a longer term and a larger population. Indirect impacts from mine development would also be local to the mine development sites but could be greater in terms of water quantity (water use), extent of impacts due to changes in drainage patterns, and potential water quality impacts from mine operations.

Marine Waters

Impacts to marine waters from spills (liquid or dust) could occur during loading of the ore concentrate at the export location. A fuel or hydraulic fluid spill could also occur during loading of the vessel. The severity of the spill would be dependent on the location, type, and quantity of material entering marine waters. Given currents and tidal effects, minor spills may dissipate rapidly, while others could create greater impacts on local fish and invertebrate populations. The effects of spills in marine waters on aquatic organisms would be similar to those described in Section 3.3.2, Fish and Aquatics. Regarding spills, see also Section 3.2.3, Hazardous Waste.

Permafrost Thaw

Impacts to permafrost and natural drainage patterns would continue to occur over the life of the project and mine operation. In areas of ice-rich permafrost, permafrost thaw and subsidence could potentially result in roadway embankment damage or changes in culvert inverts or alignments, which would cause additional changes to hydrology. Many unknowns exist because of changing active layer thickness from thawing permafrost and the way in which that affects drainage patterns. The speed of that change is dependent on many factors, including ice content, native soil materials, potential temperature rise, changes in snow accumulation during winter, and precipitation during summer. Conner and Harper (2013) discuss the different states of permafrost (sporadic, discontinuous, and continuous) and methods to maintain the integrity of infrastructure in a changing climate. Alternative C would cross areas of discontinuous permafrost, and these areas would likely see changes first. Cumulatively, Alternative C would have the most water resources impacts due to its length and the earliest permafrost effects to the stability of the roadway.

Climate Change

Climate change, discussed in Section 3.2.7, Air Quality and Climate, is large scale and affects the entire analysis area. Warmer temperatures directly result in melting of ice and thawing of permafrost, which can change precipitation patterns. Temperature increases have a perpetuating impact in a system where hydrologic patterns are tied to distinct seasonal processes (BLM 2020b). Warmer temperatures directly result in the melting of ice and permafrost, changed precipitation patterns, and redistribution in water storage. Permafrost thaw redistributes the storage of water, changing the amount and connection of lakes, indirectly impacting lake recharge rates and infiltration to groundwater.

AIDEA has proposed that communities be allowed to use the road for commercial deliveries. Therefore, other indirect impacts include the potential development of new access roads (spur roads) to tie into the Ambler Road for delivery of commercial goods and fuel supplies. Improvements to the Dalton Highway would also contribute to water quality impacts. These roads would have the same types of impacts as the development of the proposed road in terms of water resources. The connection of Alternative A or B to Bettles/Evansville would most likely be an ice road during winter, as is currently built, but only one-third the length, potentially reducing impacts. Direct connections would likely be made from Alternative A, B, or C to Kobuk, and from Alternative C to Hughes. Lesser potential exists for development of additional road access to other communities (Shungnak, Ambler, Alatna/Allakaket). Navigable river and winter trail/snowmachine access to the Ambler Road alternatives for commercial goods delivery would have lesser impacts than permanent roads.

Operational Control and Access

AIDEA is proposing strict operational controls over the road, including a staffed gate near the intersection with the Dalton Highway and full communication coverage along the road. Unauthorized use of the road could present a safety hazard for authorized road users, s. Project airstrips would be located at

construction/maintenance camps that would typically be staffed full time, so any trespass by unauthorized users at airstrips would likely be noticed immediately. As a result, the likelihood of trespass by unauthorized users to significantly impact water resources is low and generally limited to the potential for small spills associated with unauthorized vehicles.

Public and Non-Industrial Access

Potential future lawful use of the road by the public for non-industrial purposes, as described in Appendix H, Section 2.2.2, Public and Non-Industrial Access, could result in impacts to water resources; impacts are likely to be local but could be long term and potentially permanent. Likely impacts that could result from public access include spills and discharges from vehicles and equipment, fugitive dust from road use, degraded water quality from human waste, and potential for human-caused wildfire that would increase runoff volumes and increase erosion, TSS, and turbidity in receiving waterbodies. Recreational use, including rafting, boating, OHV use, and aircraft use, has potential to damage streambanks and channels, degrade vegetation, increase erosion, impact water quality (e.g., TSS, turbidity, sedimentation, DO), compact soil, develop trails, contribute to thermokarst subsidence, and withdraw water (BLM 2007). Public access could lead to increased recreational and small-scale mining (gold panning, placer mining, exploratory pits) with typically local impacts to water quality as described above for mining activities.

Fiber Optic Cable

Potential development of fiber-optic cables in the Ambler Road vicinity or along the Ambler Road corridor could lead to permafrost thaw and disruptions to existing drainage patterns resulting from trenching for cable installation.

3.2.6 Acoustical Environment (Noise)*

Affected Environment

Natural sounds (e.g., wildlife, wind, water) and human-made sounds (e.g., vehicles, aircraft, boats) comprise the acoustical environment (or soundscape). Several factors influence sound, including distance from the sound's source, terrain, vegetation or ground cover, and atmospheric conditions (e.g., wind, weather). Sounds are considered noise when they have the potential to affect the natural acoustical environment, noise-sensitive receptors (i.e., wildlife and people who experience increased sensitivity or exposure to noise during activities), and values. Noise, measured in decibels, is based on perception (i.e., whether it disrupts normal activity or diminishes quality of life), and is affected by pitch, frequency, intensity, and duration. A-weighted decibels (dBA) closely correlate to the frequency response of normal human hearing (see DOWL 2016a regarding noise metrics).

The study area is remote, with a soundscape primarily characterized by natural sounds (e.g., wildlife, birds, flowing water, wind, etc.). Human-made noise in the study area is intermittent, transitory, and generally concentrated at rivers. A South Walker Lake study site in the project area, for example, "had a time-averaged natural ambient sound pressure level…of 20.9 dBA" (Betchkal 2019). Human-made noise sources include off-highway vehicles (OHVs), snowmobiles, and motorized boats used for subsistence hunting and travel; fixed-wing aircraft and helicopter overflights; aircraft/helicopter and boat activity for recreation and research; and firearms associated with hunting.

The BLM conducted a GIS examination of the affected environment consisting of a buffered area 2.5 miles from proposed infrastructure. This buffer was based on the impact distance identified for the Red Dog Mine noise analysis (EPA 2009). Noise-sensitive receptors in the area include the community of Kobuk, approximately 1 mile from Alternative C; GAAR where Alternatives A and B transect its southern portion; people crossing or accessing the area for subsistence purposes and recreation; and

wildlife. The NPS contracted the development of a noise model to analyze noise impacts within GAAR. At the BLM's request, the NPS expanded the model calculations over the full length of Alternatives A, B, and C. See Appendix D, Attachment A, for the road model description and results (Betchkal 2019).

Part of the proposed project area overlaps GAAR. The NPS has policies/authorities to preserve soundscapes and reduce noise in NPS-managed parks (NPS 2000, 2006a, 2006b). NPS (2019a) provides further information regarding the soundscape in GAAR.

Environmental Consequences

Road Impacts

Noise associated with construction and operation of the proposed project has the potential to impact people and wildlife in or near the study area by altering the acoustic environment/soundscape. Project sources of noise include construction activities such as blasting, pile driving, operating construction equipment and vehicles, diesel generator operations at construction camps, maintenance stations, material sites and radio communication towers, aircraft take-offs, landings and overflights, and vehicle operations along the roadway. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. See Sections 3.3.2, Fish and Aquatics; 3.3.3, Birds; and 3.3.4, Mammals; 3.4.3, Recreation and Tourism; and 3.4.7, Subsistence Uses and Resources for additional information.

No Action Alternative Impacts

The No Action Alternative would not construct the proposed road, and therefore would not result in project-related noise effects for humans (residents, subsistence users, visitors) and wildlife (birds, mammals, fish) inhabiting or traversing the study area. Mining and exploration activities would likely continue, but noise impacts from these activities, including use of aircraft, would be localized, intermittent, short term, and temporary. Most of the soundscape would be expected to generally remain unchanged from current conditions.

Impacts Common to All Action_Alternatives

All action alternatives would introduce a new, 2-lane, all-season gravel road and supporting infrastructure (e.g., bridges, culverts, road maintenance stations, communication sites with towers, vehicle turnouts, material sites, access roads, airstrips) as well as associated air and ground traffic across a remote and mostly natural setting, altering its existing soundscape.

Noise from construction would dominate the acoustical environment near the activity for its duration (see Appendix D, Table 19, for noise levels for typical construction equipment and operations; the table helps to define the magnitude of impact compared to mostly natural sounds). Construction noise impacts would increase for each phase of the project based on the enlarging footprint and longer period/seasons of activities. The greatest impact during construction may come from impulsive noise (e.g., gravel mine and road cut blasting, bridge pile driving), which results in high-intensity, short-duration bursts. Noise from crushers can be at times constant and prolonged, punctuated by impulsive bursts as rock is dumped into them. Loading trucks with rocks or gravel is also a source of sudden noises. Birds and wildlife may perceive it as a threat, resulting in startle responses and avoidance. Phases 1 and 2 would likely be built as a continuous 4-year effort, with mining traffic beginning at the transition from Phase 1 to Phase 2. Sounds generated as part of the construction process would extend throughout this time, and construction camps would be nodes of activity until removed at the end of Phase 2. Phase 1 would likely create the most construction sound, because that phase would include most of the blasting and pile driving needed and the most helicopter flights. Phase 1 is expected to last 2 years, with activity occurring year-round. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Under the combined phasing option, noise associated with Phases 1 and 2 would be combined into a single phase that would be approximately 2 to 3 years long.

Construction and operation would result in increased noise from aircraft (fixed wing and helicopter), which would be used to transport cargo and/or personnel. Noise impacts from aircraft activity would vary based on the type of aircraft (smaller aircraft are likely to be used), phase (landings, and particularly take-offs at full power are generally louder than level flight), location (e.g., at specific locations such as airstrips; along in-transit flight paths; dispersed locations for exploration, research, recreation), altitude (lower is louder), frequency (1 to 4 per week per airstrip, depending on project phase), and timing in relation to locations and activities of receptors. Aircraft noise currently is the most frequent non-natural sound in much of the study area, and it would increase as a result of the proposed project. High overflights, likely most frequently from Fairbanks, located to the southeast of project airstrips, would be less disturbing than approaches and departures at project airstrips. Flights may include relatively short flights along the road between project airstrips. Because the flights would be shorter, they may not be as high and, therefore, would generate more noise in the road corridor. Helicopter flights would be much more likely during construction of Phase 1 and would include multiple low-altitude flights and take-off and landing operations along the road corridor. Load slinging operations are likely and generally include more prolonged hovering near ground level to hook and unhook loads, extending noisy periods. Sounds in the air even slightly above ground elevation would be expected to propagate farther than similar sounds on the ground, magnifying the effects of air traffic.

Construction and operation would introduce noise from ground transportation vehicles (e.g., gravel, semi-trailer, and fuel delivery trucks; lighter-duty vehicles; bulldozers; graders; compactors) into the study area. Truck traffic would increase over the 3 phases, and would be greatest once mine production peaks (maximum project annual average daily traffic [AADT] of 168 trips per day; see Appendix H). The NPS noise model assumes evenly distributed traffic throughout the year and day, averaging 6 heavy trucks per hour. The greatest contributors to road noise are vehicle braking and engine noise, and tires on the road surface. Traffic density and speed also affect road noise, with lower speed and density allowing for longer noise-free intervals. See Appendix D, Attachment A, for an estimate of decibel levels and maps showing the location of predicted noise increases (Betchkal 2019). The information helps to define the location, extent, likelihood, and magnitude of impact. Maintenance equipment likely would result in differing sound levels, depending on the maintenance task at hand. For example, plows and graders would include the sounds of the blade on the ground and often additional engine noise associated with the load the plow was pushing. Maintenance activity in a specific location using multiple vehicles would create a temporary node of activity with greater sound levels. It would be likely that maintenance sounds would occur virtually every day of the year at several locations along the road. Whether related to through traffic or maintenance, distance to where a person or animal's ability to hear traffic or construction noise would vary depending on terrain as well as temperature, wind direction, and existing natural conditions.

Overall impacts of construction and operation noise would be of medium to high intensity, local to regional extent, and construction impacts would be temporary. All project sounds would attenuate to low intensity as distance from the source increased. Construction and operation noise would potentially cause local changes in wildlife movement and distribution patterns, but would be unlikely to affect wildlife populations. See Sections 3.3.3, Birds, and 3.3.4, Mammals, for more on wildlife effects from noise. Construction and operation noise would potentially reduce the sense of isolation and solitude that village residents and visitors in and near the study area currently value.

Design features presented in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, includes measures that would reduce noise during construction and operation, such as keeping vehicles and mufflers in good operating condition. Noise barriers are not considered practical over such long distances.

Requirements such as good mufflers and limiting use of air brakes would reduce traffic sounds but would not completely stop the sound propagation from the road.

Alternatives A and B Impacts

Alternatives A and B would have similar impacts. Traffic noise impacts are identified at an average width of 3.7 miles across the lengths of both alternatives (centered on the roadway), after which natural conditions would limit a person or animal's ability to hear truck noise at distance (See Appendix D, Attachment A, which helps to define the location/extent, likelihood, and magnitude of impact). Alternative A would be located within 3.7 miles (often less than 1 mile) of the shared Park and designated Wilderness boundary for approximately 25 miles, while Alternative B would be located farther south. It would not be anticipated that the nearest communities to these alternatives (Bettles/Evansville and Kobuk, at 8 and 9 miles distance, respectively) would be affected by traffic noise under typical conditions, although residents traveling on the land or waterways or staying at outlying camps may be affected by noise from the road. Rivers are often transportation corridors and sites for camps and are likely to be the most frequently used areas.

Alternatives A and B each would have 3 airstrips, and therefore would generate air traffic and landing and takeoff noise at 3 nodes associated with maintenance camps. These alternatives would have approximately 5 construction camps in addition to the maintenance camps, which would be nodes of sound-producing activity, including activity of construction equipment and helicopters.

Alternatives A and B would cross GAAR, resulting in impacts on visitors. See also Section 3.4.3, Recreation and Tourism, regarding visitor use patterns and numbers. When compared to other NPS units in Alaska and the Lower 48, GAAR is relatively free of noise (e.g., Walker Lake North has the lowest observed noise event rate of any site in the national park system to date; Betchkal 2015). Walker and Nutuvukti lakes, near Alternatives A and B, are primary access points for the southern portion of GAAR, so visitors likely would experience noise impacts from construction and operation of the alternatives. Alternatives A and B would cross multiple rivers used for float trips, including the Kobuk Wild and Scenic River. Alternative B crosses the Kobuk and Reed rivers within GAAR, where lands are managed for natural quiet, while Alternative A crosses the Kobuk within GAAR and the Reed River outside the Preserve boundary. Visitors floating these rivers would experience noise impacts from the road. For river floaters, the road typically would be audible for a short time as watercraft approached and then floated beyond the road. Compared to areas in national parks near roads, relatively few people use the area, so few would hear the road. However, the area is specifically managed not only to maintain a natural acoustic environment but for use by few people (few encounters between people), so the low numbers and natural acoustic environment are part of the same management intent. Other rivers with float use are discussed in Section 3.4.3, Recreation and Tourism. NPS (2019a) provides further information regarding potential noise impacts in GAAR from the project.

Alternative C Impacts

Alternative C overall would generate new noise over a longer distance compared to Alternatives A and B due to the longer road and additional material and support facilities required to construct and maintain it. Alternative C proposes more and longer bridges than Alternatives A and B, which would likely require more pile driving activities. Impulsive, high intensity noise sources are often considered more intrusive to normal human and wildlife activities. Alternative C may also require longer sections of construction using rock cuts and blasting than Alternatives A and B, due to steep sections along the Ray Mountains. Alternative C would affect more previously undisturbed land than Alternatives A and B, and the impacts would spread wider due to terrain differences, averaging 5.1 miles across (centered on roadway) before natural conditions would limit the ability to hear truck noise at a distance (see Appendix D, Attachment

A, which helps to define the location/extent, likelihood, and magnitude of impact). The communities of Kobuk and Hughes, located 2 and 3 miles from the roadway, respectively, would be anticipated to perceive traffic noise from Alternative C. Vehicle trips (ground and air) and vehicle miles travelled are projected to be slightly higher for Alternative C than for Alternatives A and B (due to greater maintenance requirements), which would be expected to result in a greater overall amount of vehicle-related noise. However, given the longer road length, noise-free intervals between trucks may be longer, allowing longer periods without noise, which could be beneficial to wildlife movement (Betchkal 2019).

Alternative C would have 5 airstrips and, therefore, would generate air traffic and landing and takeoff noise at 5 nodes associated with maintenance camps. These alternatives would have approximately 8 construction camps in addition to the maintenance camps, which would be nodes of sound-producing activity, including activity of construction equipment and helicopters.

Alternative C would avoid crossing GAAR, resulting in no impact to the character of those lands. Alternative C would follow and cross many other rivers, including the Kobuk and Koyukuk rivers, resulting in noise impacts on area residents using them as travelways and visitors using them for recreation. In addition, Alternative C has greater potential for noise impacts on residents in Kobuk and Hughes, who may experience noise impacts associated with construction and operation on the portions of the roads nearest these communities. Compared to urban areas or even developed park areas with many people, relatively few people would be affected by the road noise; however, some of them are likely to be more sensitive to such noise because it would contrast with the otherwise quiet surroundings.

Combined Phasing Option

The combined phasing option would reduce the duration of construction-related noise effects under all action alternatives by approximately 1 to 2 years relative to the phased alternatives (up to 4 years total for Phases 1 and 2).

Mining, Access, and Other Indirect and Cumulative Impacts

Cumulative effects from noise are unique because noise above ambient levels occurs only when a noise-generating action is occurring, and the distance between a noise source and the receiver influences noise intensity. Louder noises tend to dominate noise levels; therefore, the cumulative effect of other noise sources may be masked by the loudest noise source. All action alternatives would elevate noise above ambient levels in the study area. When this increase in sound level is assessed cumulatively with effects of past and present activities and reasonably foreseeable developments from activities associated with mining and other Trilogy Metals and South32 exploratory work on mine claims near the Ambler Road that are outside the Ambler Mining District (both proposed within the Ambler Mining District and the new Manh Choh Mine), road traffic, airplanes, community access traffic, telecommunication improvements along the Ambler Road corridor, and Dalton Highway improvements (see Appendix H), there would be an incremental increase in noise levels, especially where noise sources are closer to communities, subsistence use and recreation areas, or other noise-sensitive locations. Intermittent noises (e.g., blasting at material sites, road cuts, and mine sites) may occur concurrently with other projects, or may increase the overall frequency of disturbances to noise sensitive areas and receptors.

3.2.7 Air Quality and Climate*

Affected Environment

Air Quality

Regulatory Environment

Ambient air quality in a given location may be characterized by comparing the concentration of various pollutants in the ambient air with the standards set by federal and state agencies. Under the authority of the CAA, the EPA has established nationwide air quality standards, known as the National Ambient Air Quality Standards (NAAQS) for 6 air pollutants. The standards set maximum allowable atmospheric concentration of these 6 criteria pollutants and were established to protect the public health within an adequate margin of safety. The ADEC has also adopted and established State of Alaska Ambient Air Quality Standards (AAAQS). Pollutants for which standards have been set include carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter less than 10 or 2.5 microns in aerodynamic diameter (PM_{10} and $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), and lead.

Two additional pollutants of concern, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) are also regulated because they contribute to the formation of ozone in the atmosphere; however, no NAAQS or AAAQS have been established for these pollutants (note, however, the criteria pollutant NO_2 is a major constituent of NO_x). EPA has also established emissions and equipment standards for 187 listed hazardous air pollutants (HAPs) for several industrial categories. Additionally, greenhouse gases (GHGs) became regulated pollutants on January 2, 2011, because of their contribution to global climate change effects. Many air quality permitting and regulation activities under the CAA are delegated to ADEC, which has also established permitting and registration requirements as well as emission standards for equipment and standards for air pollutant sources.

CEQ released new interim guidance on January 9, 2023, regarding GHGs and climate change in the NEPA process (88 *Federal Register* 1196–1212 [January 9, 2023]). This interim guidance recommends that context for the GHG emissions and climate impacts associated with a proposed action could be demonstrated by calculating estimated social cost of GHG (SC-GHG).

Existing Conditions

Emissions from natural sources such as wildfires and human-induced air pollutant emissions from industrial processes and mobile emissions affect air quality. The proposed project is in a remote area of the Northern Alaska Intrastate Air Quality Control Region (AQCR) where there are few major pollutant emission sources. The emissions produced are generally localized in residential populated areas and would be expected to be below applicable EPA-approved NAAQS (EPA 2016a) and AAAQS, see Appendix D, Table 20. There are currently no air pollutant monitoring sites located within the analysis area for this project. Air monitoring sites nearest the area are located in Fairbanks and Denali National Park and Preserve (DENA). Real-time data are available through EPA website AirNow and the Alaska air quality network. Fairbanks is a highly populated area and the air quality is not representative of the project. DENA is therefore used to characterize the affected environment. The DENA site is operated by the NPS for purposes of establishing background concentrations and trends in potential impacts to visibility in this remote area. Although this station is not used to demonstrate compliance with NAAQS (and AAAQS), data show that typical background concentrations for PM_{10}, $PM_{2.5}$, and ozone are well below NAAQS (and AAAQS) thresholds. For the previous 3 years (2019 through 2021) average concentrations of PM_{10} were 13.1 micrograms per cubic meter ($\mu g/m^3$) compared to the standard of 150 $\mu g/m^3$. For $PM_{2.5}$, the 3-year average annual concentrations was 1.7 $\mu g/m^3$ compared to the standard of 12 $\mu g/m^3$ while the 3-year average of the 98th percentile of the 24-hour concentration was 10.5 $\mu g/m^3$

compared to the standard of 35 µg/m^3. For ozone, the 3-year average of the fourth highest daily 8-hour maximum was 0.053 parts per million (ppm) compared to the standard of 0.070 ppm while average background ozone concentrations were approximately 0.033 ppm.

Air quality in specific geographic region is designated as attainment (meets air quality standards), non-attainment (air quality does not meet standards for 1 or more pollutants), or unclassifiable (insufficient data exists to determine compliance) by EPA in accordance with 40 CFR 81.302. The AQCR that the proposed project is located in is primarily designated as unclassifiable due to the remoteness of the region and lack of representative air monitoring data over the large geographic area designated mainly as attainment or unclassifiable for criteria pollutants that EPA has established NAAQS for under 40 CFR 81.302. The project is roughly 200 miles north of the closest federally EPA designated Class I protected area located with Denali National Park of the DENA. The closest population center is the Fairbanks North Star Borough (FNSB), which EPA designated in 40 CFR 81.302 as non-attainment for particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) for the 24-hour NAAQS (and AAAQS) due to its susceptibility to temperature inversions and local emissions sources such as woodstoves, industrial and residential combustion of fossil fuels, and motor vehicles with its air pollution managed ADEC manages air quality in this area under a State Implementation Plan. The area is also classified as a maintenance area for CO where, notably, industry changes have helped reduce the CO emissions from non-attainment. The combination of temperature inversions and emissions such as mobile combustion, industrial emissions, and wood-stove burning contribute heavily to pollution in Fairbanks and on main highways.

In remote areas like the project area, fugitive dust is a main source of particulate pollution (PM_{10} and $PM_{2.5}$) in the atmosphere. Particulate is often a result of wind erosion, natural and human-made (anthropogenic) fires, combustion by-products, and vehicle travel on unpaved roads. The particulate matter could contain minerals such as asbestos and others due to the geology of the area. During summer in the project area, particulates from forest fires are common. Fugitive dust generated on roads in summer is a major issue.

GAAR has participated in the Interagency Monitoring of Protected Visual Environments Network, monitoring regional haze and pollutant concentrations in precipitation (wet deposition) in Bettles. That station has been relocated to Toolik Lake and no longer collects data on the south side of the Brooks Range. Regional haze data collected from 2008 to 2015 can be found at vista.cira.colostate.edu/improve. The wet deposition data National Trends Network Station AK06 measures sulfate, nitrate, ammonium, chloride, calcium, magnesium, potassium, sodium, and mercury. Data from 2008 to the present can be found at the National Atmospheric Deposition website (nadp.slh.wisc.edu/NTN/ntnData.aspx).

Climate

The project area is located within Interior Alaska, where the climate is characterized as subarctic and semiarid. The area has microclimates that experience low annual precipitation of approximately 17 inches and a range of temperatures as high as 100°F and as low as -70°F (BLM 2016a). Lowland basins and broad valleys between the Brooks and Alaska-Aleutian ranges largely influence the climate. Area winds are dominated by wind flows from the east that reach 15 to 25 miles per hour. High winds in the lowland areas with open riverbeds often re-entrain particulates (ADEC 2016). These climate factors could contribute to haze and poor visibility, but also to atmospheric clearing.

The BLM's *Analysis of Management Situation* (BLM 2016a) has a concise summary of climate change in Interior Alaska, which is summarized in this paragraph and the following paragraph. Sources of existing GHGs in the project area are primarily a result of wildfires and located primarily in and near small communities, from on- and off-road vehicle (ORV) fuel combustion, heating of buildings, and electric power generation. All of these factors contribute to overall GHGs in the atmosphere.

The global mean surface temperature has increased since the last half of the nineteenth century, and observations and computer model predictions indicate that increases in temperature are likely to be greater at higher latitudes like those of the project area. Climate modeling predicts an increase in the length of the summer season, with fall freezes occurring later and spring thaws occurring earlier. Impacts of climate change visible in Alaska include coastal and river erosion, increased storm effects, retreat of sea ice, warming rivers and creeks, and permafrost thaw (U.S. Global Change Research Program 2018). Recent warming of the Alaskan climate has been linked to the Pacific Decadal Oscillation (PDO). PDO is a long-lived (10–20 year) El Niño–like pattern of Pacific climate variability and over the most recent 10-year period (2011–2020), the Alaskan climate was over 1 degree Celsius warmer than any other 10-year period in the twentieth century (BLM 2021). In addition, late summer Arctic sea ice coverage and thickness has decreased over the last several decades, with the lowest minimum coverage occurring in 2012 (BLM 2021). Other anticipated effects include changes in wildfire patterns and in species abundance and diversity. Warmer temperatures and a longer growing season are expected to increase evapotranspiration enough to outweigh a regional increase in precipitation (EPA 2017). Seasonal changes in climate could have profound impacts on the condition and health of wildlife habitat. Such changes could lead to increased fire risk and contribute to the likelihood of wetlands, streams, and lakes drying out (Rupp and Springsteen 2009). See Section 3.3.1 (Vegetation and Wetlands) for discussion of wildfire and wildfire management changes and impacts associated with climate change. Thawing permafrost, including thawing that may drain areas of peat, may release stored CH_4 and other GHGs (Schuur et al. 2015; Strack et al. 2019), which are anticipated to accelerate climate change and accelerate permafrost degradation. Thawing permafrost also may release to the broader environment mercury that has been locked up in frozen soil for thousands of years, a potential risk to wildlife and human health (see also Public Health discussion in Appendix H).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the proposed project would not be developed, and associated impacts on air quality would not occur. Ongoing mineral exploration supported by aircraft would continue under the No Action Alternative and would contribute to GHG emissions through fossil fuel combustion.

Impacts Common to All Action Alternatives

Air Quality

The proposed project would have the potential to impact air quality as a result of increased air pollutant emissions from road and facility construction, road and facility maintenance and operations, mobile source emissions, and fixed equipment such as generators and heating systems. The pollutants of concern that have the potential to be emitted include particulate matter from fugitive dust emission sources; criteria pollutants and hazardous air pollutants from fossil fuel combustion; and asbestos from disturbance of NOA materials. In addition, GHGs associated with fossil fuel combustion would be emitted.

Fugitive dust emissions sources would include particulates associated with road construction and maintenance activities such as scraping, grading, crushing and loading/unloading of construction materials as well as dust entrainment from processes such as vehicle traffic on the road and wind erosion to disturbed surface areas. Mobile sources of emissions would include vehicles such as cars, trucks, airplanes, helicopters, and construction equipment. Stationary sources of emissions would include generators, heaters or other equipment used for heat and energy production at construction camps,

maintenance sites, airstrips, and communications sites. Air pollutant emissions would occur during construction and after the road was completed and was traveled by vehicles and equipment.

Impacts to air quality were assessed by evaluating the type, duration, and potential magnitude of air pollutants that could be emitted by project related activities under each alternative. Estimated emissions were calculated for those activities where reasonably foreseeable data was available. Appendix D, Table 24, shows the activities that have the potential to generate emissions under construction conditions and under road operation conditions. The table helps to define the likelihood and magnitude of impact. In addition, the table show the types of pollutants potentially emitted from each activity and where data was available, the potential magnitude of those emissions.

NOA potential impacts are discussed in more detail in Sections 3.2.1, Geology and Soils; 3.2.2, Sand and Gravel; and 3.4.5, Socioeconomics and Communities (see also NewFields 2019).

During active construction of any of the proposed road alternatives, the proposed project has the potential to increase criteria pollutants and HAPs in the short term, and these emissions are subject to non-road engines and portable generator regulations such as 40 CFR 9, 69, 80, 86, 89, et al. (see Control of Emissions of Air Pollution From Nonroad Diesel Engines and Fuel, EPA Final Rule 2004). There is no specific construction and operations plan, therefore it is not possible at this time to quantify the criteria air pollutants for construction, or maintenance and operations activities. It is anticipated that the main concern would be the generation of particulate matter. Fugitive emissions made up of heavy particulates are often localized and would settle out near the proposed road. The development of an enforceable, comprehensive dust control plan is proposed as a mitigation measure. This plan would be reviewed by multiple agencies and must be approved by the authorized officer prior to any surface disturbing activities (see Appendix N). The dust control plan, with appropriate methods and usage of palliatives, would mitigate much of the construction air quality impacts associated with fugitive dust. In addition, air quality permitting requirements for the proposed construction camps would ensure compliance with regulations and would help to ensure that construction emissions would not exceed the NAAQS or AAAQS.

Air pollutant emissions from the operational phase (postconstruction), would include particulate matter emissions (fugitive dust) from wind erosion and vehicle traffic as well as criteria pollutant and HAP emissions from fossil fuel combustion in vehicles, maintenance equipment and equipment used to produce heat and power. Air pollutant emissions from mobile sources and equipment would be subject to vehicle and generator regulations such as 40 CFR 80, 85, and 86 as well as emissions standards and air permitting requirements of ADEC included under 18 AAC 50. The mitigation measures for air quality included in Appendix N, including the requirement for a Dust Control Plan and air monitoring would be effective at ensuring that emissions do not cause an exceedance of ambient air quality standards.

In the mining development scenario described in Appendix H, there would be peak traffic of about 170 1-way heavy (double trailer) truck trips per day (approximately 60,000 trips per year hauling ore and traveling across an area where there is currently no traffic). Appendix D, Tables 22 through 24, calculated annual air emissions from this traffic, including CO, NO_x, SO_2, VOCs, and PM_{10}/ $PM_{2.5}$. This emissions based approach was performed to identify anticipated emissions loading and compare alternatives. It does not seek to estimate health-based ambient air quality concentrations, which would require air dispersion modeling, but does help to define the likelihood and magnitude of impact.

The estimated emissions of criteria pollutants are similar for each alternative, with the exception of particulate matter. Alternative C is estimated to have the greatest particulate matter emissions as a result of fugitive dust over a greater length of unpaved roadway, with or without dust control. Alternative C is estimated at about 20,000 tons per year (tpy) in comparison to Alternatives A and B at approximately 13,100 and 13,900 tpy, respectively.

Impacts on air quality as a result of the proposed project traffic would be of the same type under all 3 action alternatives. Once the project road opens for use, all action alternatives would represent a similar length of vehicle-miles-traveled between the District and Fairbanks; however, Alternative C would have greater impacts due to the longer distance of double-trailer vehicles on unpaved road through undeveloped areas. Air quality impacts would also result from stationary sources such as heating plants and generators at maintenance stations, temporary construction camps, and communication tower sites.

Dust generated from project traffic is anticipated to be the primary air quality concern during road operations. Appendix D, Tables 22 through 24, summarize estimates of particulate matter generated by the operation of the road, with and without dust control. Dust from the road and its gravel-surfaced facilities (maintenance stations, airstrips, access roads) can also be entrained from wind erosion. AIDEA proposes in its application that the road and facility surfaces would be treated with a dust suppressant that would greatly decrease any potential dust entrainment. As discussed above, an enforceable, comprehensive Dust Control Plan that identifies dust control measures to be implemented would be submitted and approved by the BLM prior to the issuance of a Notice to Proceed (see Appendix N). In addition, the USACE's special conditions 22 and 23 (see Appendix N, Section 3.5), which the BLM has adopted as proposed mitigation measures, include measures to minimize airborne dust. Air quality monitoring for PM_{10} and $PM_{2.5}$ at construction camps and nearby communities, which would be part of the dust control plan, would identify issues and provide necessary data to address and mitigate. If the dust control plan is not implemented appropriately, localized air quality impacts may occur.

Dust deposition impacts are more likely to occur on other environmental resources rather than air quality. Discussions of dust deposition impacts can be found in Sections 3.2.5, Water Resources; 3.3.1, Vegetation and Wetlands; 3.3.2, Fish and Aquatics; 3.3.3, Birds; and 3.3.4, Mammals.

All action alternatives are likely to encounter or use materials with NOA during construction. Specific mitigation measures that identify controls, use, and capping to minimize exposure to NOA are discussed in Appendix N, including USACE's species conditions 29 and 30 (see Appendix N Section 3.5) which the BLM has adopted as proposed mitigation measures. To the extent that dust containing NOA may be generated by road use, levels of fugitive dust with NOA on vegetation, such as berries, are likely to remain fairly constant over time, due to the washing effect of rain. The dust would not accumulate on the vegetation. Dust on vegetation could become airborne during dry conditions, when people, animals, or wind disturbed the vegetation. Levels of personal exposure to asbestos are difficult to estimate due to variables such as moisture levels, asbestos content of the dust, and differences in activities that might disturb the dust. However, where NOA materials are used, the exposure level would be more than the potential exposures under the No Action Alternative. The EPA examined the potential for worker or personal exposures to asbestos from NOA by activity in their exposure and human health risk assessment for the Clear Creek Management Area in California (EPA 2008, 2016b). In summary, this study found that recreational activities that create the most soil disturbance and dust, such as vehicle driving and riding, releases the most asbestos into the breathing zone. Vehicle usage during construction and transportation along the road would create similar releases should materials containing NOA be encountered or used during construction.

The use of sand or gravel materials that have been tested, and are shown to have concentrations of asbestos at levels less than 0.25 percent asbestos by mass (definition of NOA in Alaska law) or less than 0.1 percent asbestos (AIDEA-proposed threshold) does not mean that those materials have no asbestos and does not mean that those materials are not capable of releasing asbestos to the air or presenting a risk to human health. For the same weight of dust created, having a higher percentage of asbestos would create a higher potential exposure.

Appendix N presents potential mitigation measures, and Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, presents design features to reduce the risk of creating airborne asbestos dust, including how the road is constructed and treatments to reduce dust during operations. With the expectation that the AIDEA design features would be implemented, application of mitigation measures in Appendix N should effectively reduce air quality impacts.

High winds would contribute to the potential of fugitive dust to contribute to regional haze concerns. Monitoring data collected in cooperation with ADEC at the Red Dog Mine evaluated total suspended particulate that makes up most of fugitive dust. Total suspended particulate contains all heavy particulates and also smaller criteria pollutant particulates of size 10 microns or less. The Red Dog Mine study (Teck Cominco AK, Inc. 2007) showed that fugitive dust emissions were highly affected by seasonal factors, and measurements were higher when temperatures dropped to near and below freezing and precipitation was low (November to April). Snow on the road may decrease dust generation from vehicle usage of the road. However, since the conventional dust control application methods depend on watering and are typically not used during freezing conditions, the potential for air quality impacts from road construction and operation to contribute to regional haze could be anticipated to be greater during freezing temperatures.

The project is located in the same region as GAAR. Its air quality monitor was discontinued in 2016; however, its data can be used for baseline assessments. Air quality monitors proposed as part of dust control plan mitigation (see Appendix N) could be used as a gauge, should any increased impacts be detected once the road was in use. While regional haze is not anticipated to be affected, the data may identify where additional control measures would be required.

Climate

GHG emissions would result from vehicle and equipment combustion during construction, and from road use once construction was complete. GHG emissions for the construction of each alternative was estimated and is presented in Appendix D, Table 25. GHG emissions from industrial transportation on the proposed alternatives, as well as GHG emissions from continued road travel to Fairbanks and rail transport to the Port of Alaska in Anchorage are estimated and presented in Appendix D, Table 26. These tables help to define the likelihood and magnitude of impact. Note that although the Port of Alaska in Anchorage was used for the basis of the GHG emissions due to indication from Ambler Metals of its likely port location, a port location has not been declared, and rail transport could potentially occur at any of the 4 export terminals in consideration: Port MacKenzie in the Mat-Su Borough, the Port of Alaska in Anchorage, Seward, and Whittier (AIDEA 2022). GHG emissions from transportation along the proposed road would be comparable to emissions from other industrial access roads in Alaska and other ROW authorizations from the BLM. While this project itself would not generate sufficient GHG emissions to affect global climate, incrementally with other projects, it would contribute to the accumulation of relatively small emissions worldwide that have together resulted in effects to the global climate. The emissions estimates address fuel usage anticipated for construction activities, and do not include potential project contributions to accelerating local permafrost thaw which would result in generating GHGs such as CH_4 and CO_2.

Appendix D, Table 26, summarizes GHG emissions in the form of tons of carbon dioxide equivalent (CO_2e) per year for the transportation associated with moving the ore to the Port of Alaska in Anchorage. Note that although the Port of Alaska in Anchorage was used for the basis of the GHG emissions due to indication from Ambler Metals of its likely port location, a port location has not been declared, and rail transport could potentially occur at any of the 4 export terminals in consideration: Port MacKenzie in the Mat-Su Borough, the Port of Alaska in Anchorage, Seward, and Whittier (AIDEA 2022). The difference would be in the spatial area that could be affected by new fugitive dust emissions along the alternative

routes and the lengths of construction of those routes and infrastructure associated with the length, such as the number of maintenance stations. GHG emissions would result from stationary sources such as heating plants and generators at maintenance stations, temporary construction camps, and communication tower sites. Aircraft using project airstrips primarily to transport maintenance and operations crews also would generate emissions from burning aviation fuels.

Social Cost of Greenhouse Gases

The social cost of carbon, social cost of nitrous oxide, and social cost of CH_4 (together, the SC-GHG) are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

On January 20, 2021, President Joe Biden issued Executive Order (EO) 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. Section 1 of EO 13990 establishes an administration policy to, among other things, listen to the science; improve public health and protect our environment; ensure access to clean air and water; reduce GHG emissions; and bolster resilience to the impacts of climate change. Section 2 of the EO calls for federal agencies to review existing regulations and policies issued between January 20, 2017, and January 20, 2021, for consistency with the policy articulated in the EO and to take appropriate action.

Consistent with EO 13990, CEQ rescinded its 2019 Draft National Environmental Policy Act Guidance on Considering Greenhouse Gas Emissions (CEQ 2021) and has begun to review (with the purpose of updating) its Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews issued on August 5, 2016 (2016 GHG Guidance) (CEQ 2016). While CEQ works on updated guidance, it has instructed agencies to consider and use all tools and resources available to them in assessing GHG emissions and climate change effects, including the 2016 GHG Guidance. On January 9, 2023, CEQ issued updated interim guidance to assist agencies in analyzing GHG and climate change impacts (CEQ 2023).

Regarding the use of SC-GHG or other monetized costs and benefits of GHGs, the 2016 GHG Guidance noted that NEPA does not require monetizing costs and benefits. It also noted that "the weighing of the merits and drawbacks of the various alternatives need not be displayed using a monetary cost-benefit analysis and should not be when there are important qualitative considerations" (CEQ 2016). SC-GHG estimates in this Supplemental EIS are provided only as a form of context for GHG emissions, which is consistent with the CEQ interim guidance on analyzing GHGs.

Section 5 of EO 13990 emphasized how important it is for federal agencies to "capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account" and established an Interagency Working Group (IWG) on the SC-GHG. In February of 2021, the IWG published *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990* (IWG 2021). This is an interim report that updated previous guidance from 2016.

Alternative A Impacts

The road segment under Alternative A would be the shortest distance (211 miles) and would result in less surface disturbance and earthwork, causing less fugitive dust during construction and operations of the proposed Ambler Road. The GHG emissions estimate for the construction of Alternative A is approximately 99,000 metric tons of CO_2e, which is equivalent to the annual energy use of 11,439 homes (using the EPA Greenhouse Gas Equivalencies Calculator, www.epa.gov/energy/greenhouse-gas-

equivalencies-calculator[14]). This estimate does not include project contributions to accelerating the localized thawing of area permafrost, which would result in generating GHGs such as CH_4 and CO_2. According to NOAA Barrow observatory's long-term records of CO, thawing permafrost in the northern region of Alaska during early winter emits 70 percent more carbon dioxide today than in 1975 (Stein 2017). As the shortest alternative, Alternative A would have the smallest footprint and may be assumed to contribute the least additional GHG emissions from permafrost thawing.

Alternative A would require less dust suppressant for treatment and would not create as much potential fugitive emissions, due to less exposed surface area. Appendix D, Table 22, summarizes the annual emissions from vehicle usage of the roadway, including particulates (both with dust control and without) for Alternative A. As the shortest alternative, Alternative A emissions are the least compared to the Alternative B and C segments of the Ambler Road; however, when examined in combination with emissions associated with the remaining road distance to Fairbanks, most criteria air pollutants and GHG emissions are similar in magnitude (see Appendix D, Tables 23, 24, 26, and 27). These tables help to define the likelihood and magnitude of impact and the estimated total SC-GHG.

Alternative A would have 3 airstrips and maintenance stations that would be additional sources of emissions from aircraft, generators, and heating systems. The nearest communities to Alternative A are Bettles and Evansville, which are 8 miles away from the road (and much greater distances to probable locations of airstrips and maintenance stations). It is anticipated that impacts or exceedances to air quality thresholds would be minimized by distance to sources, the short duration the construction seasons, and operator-committed measures to address dust control, although no quantitative modeling has been performed. Appendix F, Table 1, documents the distances of communities to the alternatives. The short-term construction and the operation of the Alternative A road would have localized air quality impacts without frequent application of dust suppressants, but would not be expected to exceed applicable air quality standards. Local exceedances of air quality standards could occur without frequent reapplication of suppressant.

Alternative B Impacts

Air quality impacts under Alternative B would be expected to be similar to Alternative A, with the exception of generally greater fugitive dust and engine emissions due to the longer route (additional 17 miles), which would increase construction time and road miles traveled during use. The GHG emissions estimate for the construction of Alternative B is approximately 111,000 metric tons of CO_2e, which is equivalent to the annual energy use of 12,812 homes (using the EPA Greenhouse Gas Equivalencies Calculator, www.epa.gov/energy/greenhouse-gas-equivalencies-calculator). This estimate does not include project contributions to accelerating the localized thawing of area permafrost, which would result in generating GHGs such as CH_4 and CO_2. According to NOAA Barrow observatory's long-term records of carbon dioxide, thawing permafrost in the northern region of Alaska during early winter emits 70 percent more carbon dioxide today than in 1975 (Stein 2017). Alternative B would have a larger footprint than A, and may be assumed to contribute to larger GHG emissions from permafrost thawing.

Alternative B air emissions quantities are greater than Alternative A and less than Alternative C based on the Ambler Road only; however, when examined in combination with emissions associated with the remaining road distance to Fairbanks, emissions of most criteria air pollutants are similar in magnitude.

[14] This calculator can also be used to provide comparisons to vehicle miles traveled, gallons of gasoline, percentage of a coal-fired power plant annual emissions, or even number of cellphone batteries charged, as may best be comprehended by various users.

There would be similar additional fugitive dust, engine emissions, and need for dust suppressants along the Dalton Highway as Alternative A. Appendix D, Tables 22 through 24 summarize the annual emissions, including particulates (both with dust suppression and without) for Alternative B, and help to define the likelihood and magnitude of impact. Alternative B would have 3 airstrips and maintenance stations that would be sources of emissions from aircraft, generators, and heating systems. The nearest communities to Alternative B are Bettles and Evansville, which are 8 miles away and would experience little to no air quality effects, although no quantitative air quality modeling has been performed. Appendix F, Table 1, documents the distances of communities to the alternatives and helps to define the likelihood of impact. The short-term construction and the operation of the Alternative B route would have localized air quality impacts without frequent application of dust suppressants, but would not be expected to exceed applicable air quality standards.

Alternative C Impacts

The impacts of Alternative C on air quality would be similar to impacts under other alternatives. Air quality impacts would affect a larger area over a longer period of time due to more surface disturbance and likely a longer construction period. As the longest route with the biggest footprint and the most maintenance and communications facilities and airstrips, it would generate the greatest amount of fugitive dust and engine emissions attributable to construction, operations, and maintenance between the District and the Dalton Highway. The GHG emissions estimate for the construction of Alternative C is approximately 154,000 metric tons of CO_2e, which is equivalent to the annual energy use of 17,816 homes (using the EPA Greenhouse Gas Equivalencies Calculator, www.epa.gov/energy/greenhouse-gas-equivalencies-calculator). This estimate does not include project contributions to accelerating the localized thawing of area permafrost, which would result in generating GHGs such as CH_4 and CO_2. According to NOAA Barrow observatory's long-term records of carbon dioxide, thawing permafrost in the northern region of Alaska during early winter emits 70 percent more carbon dioxide today than in 1975 (Stein 2017). Alternative C has the largest footprint, and may be assumed to contribute to larger GHG emissions from permafrost thawing.

Alternative C emissions quantities are greater than Alternatives A and B segments of the Ambler Road; however, when examined in combination with emissions associated with the remaining road distance to Fairbanks, most criteria air pollutants are similar in magnitude. Alternative C would generate less dust and engine emissions, and would have less need for dust suppressants for the road segment along the Dalton Highway and to Fairbanks, compared to Alternatives A and B. Appendix D, Tables 22 through 24, summarize the annual emissions, including particulates (both with dust suppression and without) for Alternative C and help to define the likelihood and magnitude of impacts. The overall travel distance is similar; therefore, the total dust, emissions, and dust suppressant usage would be similar among all alternatives.

Alternative C would have 5 airstrips and maintenance stations that would be sources of emissions from aircraft, generators, and heating systems. The nearest communities to Alternative C are Kobuk (2 miles), Hughes (3 miles), and Shungnak (5 miles). Because of the distances and generally windy environment, ambient air quality impacts would be expected to be negligible, although no quantitative modeling was performed. Dust plumes may be visible particularly from Kobuk. Appendix F, Table 1, documents the distances of communities to the alternatives. Alternative C would have localized air quality impacts without frequent application of dust suppressants, but would not be expected to exceed applicable air quality standards.

Combined Phasing Option

The combined phasing option would reduce the duration of construction under all action alternatives by approximately 1 to 2 years relative to the phased alternatives (up to 4 years total for Phases 1 and 2). As a result, the amount of construction-related emissions and fugitive dust may be slightly reduced under the combined phasing option, depending on the type and quantity of construction equipment that is used within the 2- to 3-year duration. Although the duration of construction may be shortened under the combined phasing option, it is unknown whether the type and quantity of equipment used would be similar to the phased options or if a greater amount of equipment would be used in order to compensate for the shortened construction duration.

In addition, as described in Sections 3.2.1 (Geology and Soils) and 3.2.5 (Water Resources) the combined phasing option has potential to reduce the impacts to permafrost and thaw-sensitive soils by limiting temporary disturbances, construction staging, and construction activities to a single construction phase (direct to Phase 2 standards), which in turn would reduce the potential for GHG emissions from permafrost thawing under all of the action alternatives.

Mining, Access, and Other Indirect and Cumulative Impacts

The proposed project is located in a remote area that is designated mainly as attainment or unclassifiable for criteria pollutants for which EPA has established NAAQS under 40 CFR 81.302 and for which the State of Alaska has establish AAAQS. The area does not contain many sources of emissions other than dust from surface wind erosion, emissions from wildfires, emissions from on- and ORV travel, and emissions from community sources such as generators, heating equipment, and vehicles. Remote activities such as on- and off-road travel result in air quality impacts that are comparatively less than fugitive emissions from fires in the area. The cumulative impacts in the area as a result of wildfire may be partially mitigated from activities such as wildfire management practices (e.g., fire suppression, prescribed fire, mechanical or chemical treatments to fuels, prevention of human-caused fires).

Cumulatively, potential impacts on air quality would result from the proposed project, recreational use, mineral exploration and development activities, construction of other roads, and transport along roadways. No activities that would require air quality permitting would be permitted if they would be likely to exceed the NAAQS or AAAQS. Therefore, these activities combined are unlikely to exceed regional air quality standards. Increased vehicle traffic through Fairbanks would contribute emissions, potentially increasing $PM_{2.5}$ concentrations and furthering the non-attainment status of the area for that pollutant.

The air quality impacts associated with reasonably foreseeable mining activities would be analyzed on a case-by-case basis as part of each site's own permitting process and would be subject to appropriate measures to reduce impacts unique to each proposal. The project area would be considered to be in an attainment area, and for major sources of emissions that a mine could trigger, EPA could require a prevention of significant deterioration permit. The ADEC has regulatory authority for air permits under a delegation from the EPA. The EPA has stated its concerns in previous comments on the Draft EIS that the foreseeable mining activity could cause substantial impacts to regional air quality and air quality related values such as visibility and plant/wildlife welfare. An evaluation of project impacts on ambient air quality standards would be required, including analysis of soils, vegetation, and visibility impacts. Permitting and analysis of mines would be expected to help reduce the potential to exceed air quality standards, as emission control technology review would be required.

The Donlin Gold Mine is a recent conventional example of a mine reviewed for air quality impacts (USACE 2018). The potential for increased emissions from mining due to vehicular traffic, fugitive, and

stationary emission sources was analyzed. Main components of the operation infrastructure evaluated included mining and milling facilities, waste rock dumps, haul roads, tailings facility, generators, boiler, and a waste incinerator. The construction and closure impacts on applicable air quality standards were predicted through air dispersion modeling methods not to exceed NAAQS. Operational impacts were estimated to be above thresholds requiring more stringent permits, such as a Title V Operating Permit (required under the Clean Air Act for "major" sources of air pollutants), and to trigger GHG reporting; however, the impacts were anticipated to be below regulatory standards. Impacts from mines in the District would be site-specific and permitted specifically to proposed operations and potential emissions to avoid exceeding air quality standards.

Air quality impacts are anticipated from North Slope oil and gas development, the expansion of the Red Dog Mine for its operating life through closure, Dalton Highway construction and increased traffic due to regular LNG transport to Fairbanks, and climate change as a result of increased fuel combustion. Impacts from each of these actions may be substantive in their localized areas, but they are far enough away from the proposed road and indirect mine development that they are not anticipated to be additive within the project area.

Any of the action alternatives, in combination with past, present, and reasonably foreseeable activities, is expected to increase air emissions, including GHGs, in the region and state. The only discernable cumulative differences among the alternatives would be attributable to the direct impacts, primarily associated with the length and operational features of any given alternative (see Chapter 2, Section 2.5, Summary of Impacts, for a summary of severity of impacts). While the air quality impacts of any action alternative would be highly localized and often short term, and would not be predicted to be above applicable air quality standards, cumulatively the project would contribute GHGs to the atmosphere. While this project itself likely would not substantially affect air quality in the project area, with other emissions and other projects nationally and globally, it would contribute incrementally to far-reaching effects, including ecological and socioeconomic effects of climate change in the project area (as discussed in other sections of this Supplemental EIS). Road project effects and mining project effects of the types discussed in this Supplemental EIS that can hasten permafrost thaw, coupled with the effects of a generally warming climate on permafrost, could cumulatively release CH_4 and further contribute to climate change. Current CH_4 emissions from melting permafrost are estimated at approximately 1 percent of global CH_4 budget, but are anticipated to grow to be the second largest anthropogenic source of GHGs by midcentury (NASA 2018; Schaefer et al. 2014; Walter Anthony et al. 2018).

The potential impacts to the project from climate change could result in economic concerns due to extreme weather events that cause increased occurrences of severe flooding or drought conditions leading to schedule disruptions and the need for more sustainable construction materials during the construction phases and have the potential to damage infrastructure and increase frequency of O&M activities. Analysis of how the design parameters of bridges and culverts for this project considers these extreme weather events and their potential impacts to O&M activities is considered in Section 3.2.5, Water Resources, Road Impacts).

3.3. Biological Resources*

This section addresses vegetation and wetlands, fish and aquatics, birds, and mammals. Together with humans, insects, fungi, and microscopic life forms, these make up the biodiversity of species on earth and the biodiversity of a specific region. Scientists are concerned about a recent increase in the rate of species extinction and the loss of biodiversity globally. Pollution, climate change, and human population growth are threats to biodiversity (National Geographic Society 2019). Biological resources are a key concern to

the Tribes living in the region. Tribes are acknowledged for their special expertise as expert knowledge holders regarding the biological resources of their homelands. During a consultation in Allakaket Village, an Allakaket tribal member said:

> *We are one with nature and we are one with the land. We want to protect our heritage and we want to protect this area. The wildlife and nature are not able to speak up…We're the ones that have to speak for them.*

As indicated during G2G consultation, key concerns from the Tribes include fish habitat and spawning—introducing pollutants to the water, increased silt and slumping from permafrost melt effecting spawning sites; birds and mammals—direct mortality from the road, polluting animal food resources, altering migration patterns; vegetation—polluting vegetation and destroying habitat.

The following subsections and the corresponding subsections in Appendix H, taken together, address the biodiversity of the Northcentral Alaska study area and risks to species and populations. A "population" is the group of individuals of the same species living in the same geographic area and generally dependent upon one another (e.g., breeding) to persist as a population over time. Most development projects that remove vegetation, turn soil, create unusual emissions, or create barriers to movement in a mostly natural environment would affect individual animals and plants and may affect species populations in that area. Effects to a population may be effects to the size or density of a population or the birth/death/regeneration rates within a population. The sections that follow address the Ambler Road project's potential effects on populations and species diversity.

3.3.1 Vegetation and Wetlands*

Affected Environment

Vegetation

The proposed alternatives traverse the lowlands, highlands, and mountain foothills in Interior Alaska. The broad regional project area is bounded to the east by the Dalton Highway, to the north by the Brooks Range southern foothills, to the south by the Yukon River, and to the west by the Selawik NWR. Alternatives A and B primarily follow portions of the Koyukuk and Kobuk River valleys located within the Kobuk Ridges and Valleys (Kobuk) ecoregion, with minor portions of the routes passing through the Brooks Range and Ray Mountains ecoregions. Approximately 44 miles of Alternatives A and B (26 miles under Alternative A and 18 miles under Alternative B) pass through GAAR. Alternative C is primarily located within the Kobuk and Ray Mountains ecoregions, intersecting with the Dalton Highway at the Yukon River crossing, and crossing both the Koyukuk and Kobuk rivers south of Alternatives A and B (see Volume 4, Map 3-07; Nowacki et al. 2001). Appendix E (Chapter 3 Biological Resources Tables and Supplemental Information), Table 1, provides a description of ecoregions.

Vegetative communities in this vast and largely roadless region are predominantly undisturbed. Areas of disturbance include remote villages (mostly along the Kobuk and Koyukuk rivers), which is primarily related to infrastructure, small roads and trails associated with nearby communities, and historic and contemporary mining operations (see Section 3.4, Social Systems, for more details). Forests and woodlands are common at lower elevations, with black spruce (*Picea mariana*) in wetland bogs; white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*) along rivers; white spruce, paper birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*) on well-drained uplands; and shrub communities at higher elevations dominate the Kobuk ecoregion (BLM 2016a; Fulkerson et al. 2016; Nowacki et al. 2001). Black spruce woodlands; white spruce, birch (*Betula* spp.), and aspen (*Populus* spp.) on south-facing slopes; white spruce, balsam poplar, alder (*Alnus* spp.), and willows (*Salix* spp.) in

floodplains; and shrub birch and dryas-lichen tundra at higher elevations comprise the Ray Mountains ecoregion (Fulkerson et al. 2016). Tussocks, shrubs, mixed forest, and alpine tundra on the southern side of the range dominate the Brooks Range ecoregion (Fulkerson et al. 2016).

Mapping and tabular data used in this analysis are based on the Central Yukon Rapid Ecoregional Assessment (REA) GIS output. The Central Yukon REA dataset classifies vegetation into 15 vegetation classes, including 7 regionally important community types, referred to as Terrestrial Coarse-filter Conservation Elements (TCEs), based on similar biological and physical characteristics (Boucher et al. 2016). All TCE vegetation types occur in the project area. The most prevalent vegetation types traversed by the alternatives and the project area are upland low-tall shrub and upland mesic spruce forest. Riparian forest and shrub and alpine and arctic tussock tundra are the least abundant of the TCE vegetation types. Of all the vegetation communities near the project area, emergent herbaceous wetlands, grassland-herbaceous, and moss-dominated communities are the scarcest. The Central Yukon REA Final Report (Boucher et al. 2016) and Appendix E (Chapter 3 Biological Resources Tables and Supplemental Information), Table 2, describe the vegetation types. Volume 4, Map 3-08, shows the vegetation types in the project area. Appendix E (Chapter 3 Biological Resources Tables and Supplemental Information), Table 3, provides percentages of vegetation types shown within the extent of Volume 4, Map 3-08 to provide context of the ecoregions and alternative alignment locations within the region.

Wetlands

Wetlands are described in this section as a subset to the vegetation resource. Surface waterbodies are outlined in Section 3.2.5, Water Resources. The USACE has jurisdiction over waters of the United States (of which wetlands are a subset) under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act of 1899. A permit from the Corps of Engineers is required for the discharge of dredged or fill material into WOTUS.

The wetlands analysis used a combination of mapping products to provide a regional context for wetlands and to compare impacts among alternatives. The regional analysis was done using the Alaska Center for Conservation Science (ACCS) mapping (see Volume 4, Map 3-09A). Appendix E (Chapter 3 Biological Resource Tables and Supplemental Information), Table 4 provides a crosswalk from broad aggregated wetland categories to finer scale wetland types and their descriptions and Table 5, provides percentages of aggregated wetland types shown within the extent of Volume 4, Map 3-09A, to provide context of the wetland types in the project area; however, the ACCS mapping greatly underestimates the true extent of wetlands in the area, which should be a consideration for the following alternatives analysis. Finer scale wetland mapping was prepared for the Alternative A and B alignments which is suitable for permitting and alternatives analysis (DOWL 2014a, 2016b). No fine-scale wetland mapping is available for the Alternative C alignment and it was analyzed using the ACCS regional mapping.

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands are common in the region (Hall et al. 1994) and along the areas traversed by the alternatives (DOWL 2014a, 2016b), with up to 60 percent of the landscape meeting the vegetation, hydrology, and soils requirements for wetlands. is Discontinuous permafrost is found throughout most of the region with many areas of ice-rich and thaw-sensitive terrain (Fulkerson et al. 2016; see Map 3-01 in Volume 4). Surface and subsurface water perched on the permafrost layer is the primary driver of most wetlands in the region, creating broad wetland mosaics on flats and gentle lower slopes. Several large river valleys are found within the region which account for extensive floodplain wetlands with associated riparian shrub and forest wetlands (see Section 3.2.1, Geology and Soils).

Based on available fine-scale wetland mapping, palustrine scrub-shrub (PSS) and palustrine forest (PFO) are the most abundant wetland types along the alternatives (DOWL 2014a, 2016b). Both PSS and PFO wetlands are most associated with saturated wetland mosaics supported in permafrost rich lowlands and lower slopes. Palustrine emergent (PEM) and palustrine moss/lichen (PML) wetlands also occur along the alternative alignments and in the project area but are less common. PEM and PML wetlands tend to occupy smaller landscape features such as depressions, lacustrine fringes, and seasonally flooded riparian areas. Appendix E (Chapter 3 Biological Resource Tables and Supplemental Information, Table 4).This section focused primarily on vegetated wetlands, additional information on surface waters in the project area can be found in Section 3.2.5, Water Resources, The Nutuvukti Fen is a patterned fen unique to the area located approximately 0.25 mile downgradient of the footprint of Alternative A (Map 3-09B). The fen is recharged by drainage through glacial outwash moraine crossed by the proposed road alignment. This fen has been reported to provide many important functions in GAAR such as regulating flood flows; removing sediment, nutrient, and toxicant; and providing habitat for birds, mammals, and fish (ABR 2017). As noted by NPS (2019a), there are few patterned fens in all Interior Alaska, of which Nutuvukti Fen is one of the largest. According to NPS (2019a), upstream impoundments, should they occur, could disrupt recharge of this fen. The Nutuvukti Fen is located within GAAR and is subject to NPS management (Lanagan 2021).

Wetland functions are the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of a wetland ecosystem (ASTM 1999). DOWL (2014a) provided a wetland functional assessment for a portion of Alternatives A and B. ABR, Inc. – Environmental Research & Services (ABR 2017), completed a functional assessment and impact analysis for the portions of Alternatives A and B that traverse GAAR. Functional assessments, to date, have not included Alternative C or the eastern 50 miles of Alternatives A and B. Both functional assessments identified 12 common wetland functions across all mapped wetland types, including flood flow regulation; sediment, nutrient, and toxicant removal; erosion control and shoreline stabilization; organic matter production and export; maintenance of soil thermal regime; threatened and endangered species (TES) support; bird and mammal habitat suitability; fish habitat suitability; rare plant habitat and native plant diversity; subsistence use; and groundwater discharge and groundwater recharge. Wetlands in the region are generally considered pristine because they are intact and thus they are considered to be in reference condition (i.e., functioning at maximum capacity). The wetland functional assessments conducted for the project area also compares wetland function within the 12 categories listed above relative to the range of wetlands mapped within the region. Within the 50-mile corridor in GAAR the highest overall functional rankings were within the riverine PSS, PEM, and PFO wetland types, with PFO types accounting for the highest rankings within the maintenance of soil thermal regime and bird and mammal habitat support (Ives and Schick 2017). While the results of the GAAR analysis cannot be extended to all the alternatives, similar wetlands do occur along all alternatives in the context of boreal forest areas with discontinuous permafrost generally located along the southern foothills of the Brooks Range. Areas as risk of permafrost thaw occur throughout the project area and the maintenance of existing permafrost conditions in the region may be the most important function performed by these wetlands. Thaw protective mitigation measures have been included by the applicant in proposed mitigation measures.

Rare Plants

The U.S. Fish and Wildlife Service (USFWS) (Swem 2020; USFWS 2019) reports no federal Endangered Species Act (ESA) listed plant species in the project area. ACCS maintains a rare plant list for Alaska which also tracks BLM listed sensitive and watch species (Map 3-10, BLM 2019). The location data shown on Map 3-10 were requested in 2023 from ACCS within a 50-mile corridor surrounding all action alternatives. Appendix E, Table 6, provides a list of known rare plant collections within the 50-mile corridor. ACCS (2019a) reports Yukon aster (*Symphyotrichum yukonense*) within the footprint of

Alternative A; which is a BLM Sensitive Species (BLM 2019; Nawrocki et al. 2013). Three taxa; Hudson Bay sedge (*Carex heleonastes*), thinleaf cottonsedge (*Eriophorum viridicarinatum)*, and Kokrine's locoweed (*Oxytropis kokrinensis,* BLM Sensitive species)were found within 0.25 mile of the project footprint. Additionally, 6 plant species on the BLM watchlist are found within the 50-mile corridor and another 11 plant species not monitored by the BLM but rated as an S3 or above state rank (see Table 6 and Map 3-10). Rare plant collections range in date from 1905 to 2008 and are primarily centered around Alternatives A and B, especially within the GAAR boundaries. The lack of known collections does not indicate the lack of rare plant species but presence of rare plants can be estimated by identification of preferred habitats along the alternatives. No new surveys were conducted along the proposed alignments to support the NEPA process assuming that if isolated or large populations of undocumented rare plants were discovered, the alignments would be adjusted to avoid impacts. Surveys along the preferred alternative would be necessary to confirm the presence or absence of rare plants in these areas and these could be done during design and permitting to avoid or mitigate for potential effects. A mitigation measure requiring such surveys appears in Appendix N.

Non-native Invasive Plants

Non-native species of plants and animals can be harmful if introduced in an environment where they can flourish and out-compete native species. However, because non-native invasive animals have not been detected in the study area, and infestations are unlikely, only non-native invasive plants are discussed in this Supplemental EIS. Non-native invasive species (NNIS) are those that succeed in a new environment and may compete with and/or interfere with the growth of native species. A new species may have few natural limits on its reproduction and growth in a new environment (e.g., it is not a food source), and it may be able to successfully dominate other species that are part of a balanced ecological web. Biodiversity may be reduced if NNIS are highly invasive sometimes out-competing all native vegetation and forming pure stands (Carlson et al. 2008, 2016; BLM 2016a). In the wild, changes in plant cover can affect wildlife, including aquatic life, and change fire regimes, water flow and erosion profiles, and aesthetics (Carlson et al. 2008, 2016). NNIS also can affect farming and human developments, but those effects are of little issue in the project area (Carlson et al. 2008). Reversing an invasion of NNIS can be difficult and costly, or impossible.

Plant NNIS occur in high concentrations in the project area immediately adjacent to the Dalton Highway (Carlson et al. 2016, Map 3-11). Low to moderate concentrations occur in and around communities, including stretches of river used by communities, in southern portions of GAAR, and in the Ray Mountains. Previous studies documented bird vetch (*Vicia cracca*), rated as highly invasive, within the area of Alternative C adjacent to the Dalton Highway (AKEPIC 2019; BLM 2013c; Carlson et al. 2008, Map 3-11). Available data are limited in scope to the Dalton Highway; GAAR; and the communities of Evansville, Bettles, Alatna, Allakaket, Kobuk, and Rampart with no dedicated surveys along the proposed alternatives. New data were requested from ACCS and no new observations were recorded in the study area. Dominant vascular species, mostly centered around the Dalton Highway include white sweetclover (*Melilotus albus*), narrowleaf hawksbeard (*Crepis tectorum*), meadow foxtail (*Alopecurus pratensis*), foxtail barley (*Hordeum jubatum*), pineapple weed (*Matricaria discoidea*), and bird vetch. Of the 32 invasive species found in the study area, quackgrass (*Elymus repens*), orange hawkweed (*Hieracium aurantiacum*), and butter and eggs (*Linaria vulgaris*) are prohibited or restricted for use in Alaska. Most documented species are weakly to modestly invasive with European bird cherry (*Prunus padus*), orange hawkweed, Siberian peashrub (*Caragana arborescens*), and white sweetclover rated as highly to extremely invasive by ACCS (Carlson et al. 2008, Appendix E Table 7). Map 3-11 displays all known NNIS observations and modeled invasiveness vulnerability ratings for watersheds within the study area. Vulnerability ratings were derived from modeled data, which are presented in Carlson et al. (2016).

Carlson et al. (2016) recognize waterweed (*Elodea* spp.) as a serious threat to the ecology of freshwater systems; however, it is not known to occur in the waters crossed by the alternatives but no targeted studies have been conducted along the proposed alternative alignments (Carey et al. 2016). Prior to 2019, the closest, well-documented infestations of *Elodea* were found in Chena Slough, Chena River, and Chena Lakes in urban areas of Fairbanks (Carey et al. 2016; Fairbanks Soil and Water Conservation District 2019). *Elodea* has also been recently documented in Totchaket Slough, southwest of Fairbanks and Manley Hot springs along the Tanana River (Larsen et al. 2020, Morton et al. 2019; Fairbanks Elodea Steering Committee 2017). Since 2019 the *Elodea* detection program has surveyed approximately 500 locations within a 50-mile corridor of the proposed alternatives, primarily in GAAR but also locations along the Dalton Highway, near Evansville, and in the headwaters of the Selawik River in the Selawik NWR. No *Elodea* infestations have been found during the recent NPS surveys to date (Larsen et al. 2020). However, some rivers in the study areas, including the Koyukuk, Indian, Melozitna, and Tozitna rivers (Volume 4, Map 3-12; BLM 2013f), are susceptible to *Elodea* infestation. Current *Elodea* infestations in Alaska are suspected to have been spread via downstream fragment drift, floatplane, and boats (Carey et al. 2016; Moses 2016).

Wildfire Ecology and Management

Wildfires are part of the natural ecology of the project area and are the main driver of vegetation succession. Fire frequency, size, and severity vary based on vegetation, climatic conditions, and topography (BLM 2016a). Wildfires are common in the Kobuk ridges and valleys during warm, dry summers with frequent lightning (ADF&G 2006). The climate in the Ray Mountains is relatively warm and moist with occasional wildfires (BLM 2016a). Wildfires are less common in the Brooks Range than other lowlands in the study area (Fresco et al. 2016). Lightning causes most wildfires in these ecoregions, with the most frequent and largest occurring in low-lying forested landscapes (BLM 2016a).

The project area generally reflects a natural fire regime (BLM 2016a). BLM's historical fire geospatial data from 1959 to 2018 show frequent fire starts in and around the proposed alternatives and fire sizes ranging from less than 50 acres to hundreds of thousands of acres (BLM 2019; Volume 4, Map 3-13). Note that there are more small starts and fewer large fire size polygons near roads and rivers because these are areas designated for increased fire suppression. See Fresco et al. (2016) for information on fire return intervals (predicted frequency) for the study area ecoregions.

The BLM Alaska Fire Service (AFS; BLM 2016a) provides wildfire protection for the area. Jurisdictional agencies (federal, state, and municipal) and landowners (private and Alaska Native Corporations), along with the BLM AFS, update wildfire management options annually, and the Alaska Interagency Coordination Center (AICC) maintains a webmap. Federal and state agencies, in cooperation with Alaska Native entities, employ 4 wildfire management options: Critical, Full, Modified, and Limited (AICC 2023). The project area is primarily located in Limited and Modified management, although Full and Critical options surround nearby communities within the project area (BLM 2016a; Volume 4, Map 3-14). Currently, fire suppression and surveillance efforts in the project area are highly dependent on aircraft based out of Fairbanks and Galena. During times of high activity in the Kobuk and Noatak valleys, Dahl Creek has been set up as a remote fueling site and staging area. See BLM (2016a) and the Alaska Interagency Wildland Fire Management Plan (AICC 2023) for more details on wildfire management.

Environmental Consequences

Maps 3-08, 3-09A, and 3-09B in Supplemental EIS Volume 4 provide context for the location, extent, and likelihood of impacts to wetlands and vegetation from the proposed road project.

Road Construction and Operation Impacts

No Action Alternative Impacts

Under the No Action Alternative, project development would not happen; therefore, no impacts to vegetation, wetlands, rare plants, ecosystems, wildfire ecology, and wildfire management from road development would occur. Ongoing impacts related to past and present development in the project area would continue to occur, including further spread and establishment of NNIS along the Dalton Highway and near locations of human development. Vegetation and wetland resources would continue to be impacted by changing climate conditions (see Sections 3.2.1, Geology and Soils, and 3.2.7, Air Quality and Climate).

Impacts Common to All Action Alternatives

Vegetation Impacts

Construction and operation activities that would impact vegetation include the placement of gravel fill, excavation of surface layers during construction and gravel mining, vegetation clearing, and fugitive dust fallout from construction and operation activities. Road closure and reclamation at the end of the road's life would be expected to impact vegetation in similar ways as construction. The primary effects to vegetation from these activities would be the direct loss of vegetation types that occur in project footprints, and alteration or degradation of vegetation communities due to indirect effects. Primary adverse effects would result from: changes to soil, changes in surface water drainage patterns reduction in permafrost and active layer distribution and thickness, vegetation distribution and diversity, increased erosion and sedimentation, and introduction of NNIS. Permanent loss of vegetation types within the project footprint would also result in to loss of and changes to fish and wildlife habitat (see Sections 3.3.2, Fish and Aquatics, 3.3.3, Birds, and 3.3.4, Mammals). Although these types of impacts would be common to each action alternative, the vegetation types, habitat quality, and acreages impacted would vary based on the location of each alignment. Phases 1 and 2 have smaller gravel fill and excavation footprints and would have less direct impact on vegetation. Indirect impacts in Phases 1 and 2 would be reduced for some impacts because the construction time period would be shorter. This analysis focuses on Phase 3, which would have the most adverse effects on vegetation because of its larger footprint, higher traffic volumes, and longer duration. Appendix E, Tables 8 through 10, show the calculated acreages of impact to vegetation within the construction limits, the 10-foot construction buffer, and a dust impacts buffer for Alternatives A, B, and C, to illustrate the magnitude of loss and degradation to vegetation.

Fugitive dust generated from the placement of fill material during construction and roadway operations has an adverse effect on vegetation communities adjacent to the roadway in arctic and near-arctic regions. Research has shown that dust particles can travel up to 656 feet (200 meters) from roadways (McGanahan et al. 2017; Myers-Smith et al. 2006), but the greatest impact to vegetation from dust occurs within the first 328 feet (100 meters) (Auerbach et al. 1997; McGanahan et al. 2017; Myers-Smith et al. 2006; Walker and Everett 1987;). A study of fugitive dust at the Red Dog Mine (Teck Cominco AK, Inc. 2007) found higher fugitive dust emissions when temperatures were at or below freezing and precipitation was low. When low temperatures and humidity conditions are present, dust may travel long distances in the direction of prevailing winds. In general, studies have shown an adverse effect of reduced biodiversity of lichen and moss species; however, some vascular plants show increased growth near the edge of the road where thicker dust deposits help to increase temperatures during the growing season.

During construction, a 10-foot construction buffer surrounding the fill limits would be cleared and graded to support heavy equipment and staging. Impacts within the 10-foot construction buffer zone would be limited to the construction period of all project phases and would impact soil, hydrology, and vegetation. Vegetation would be cleared and heavy equipment would cause rutting and soil compaction. These effects

could increase soil bulk density (Trombulak and Frissell 2000), hinder root establishment, and reduce water and air infiltration (Passioura 2002; Nawaz et al. 2012), which could reduce plant establishment and growth. Removal of surface layers could cause increased soil erosion from water or wind and increased sedimentation. During construction, equipment use could reduce the thickness of the insulating active layer, which could result in changes to the thermal regime, causing permafrost thaw and subsequent thermokarsts. Portions of the temporary 10-foot construction buffer zone would not return to undisturbed conditions because the area would likely be cleared periodically after the road construction was completed as part of maintenance operations (NRC 2003).

As a result of changes caused by permafrost thaw, increased wetness or flooding of adjacent vegetation could occur in some areas; inundation of vegetation not adapted to wet conditions could cause mortality of vegetation and shifts in vegetation communities (Jorgenson et al. 2001). In other areas, permafrost thaw could cause increased drainage, resulting in a shift to vegetation communities better adapted to drier conditions. Alternatives A and B would generally run perpendicular to the slope of surrounding terrain, which could result in impounding surface water and vegetation flooding, changing the thermal regime of underlying permafrost. Alternative C would also run perpendicular to slope gradients and through valleys and would also have the potential to impound surface water in those areas, with similar impacts. Additionally, and for all alternatives, permafrost thaw could cause gradual movement of wet soils down slope (solifluction) and large-scale slope failure, which could result in the alteration of vegetation communities (see Section 3.2.1, Geology and Soils).

For this project, trucks containing heavy metal ore are proposed to be containerized, which is expected to limit ore dust escapement during ore hauling. An estimated 168 trucks per day (at peak production) would haul mining materials, including concentrates containing copper, zinc, lead, silver, and gold, along the road (see Appendix H), which could result in escapement of ore dust during transportation. Studies show that even with a change from tarps to hydraulically sealed lids and truck rinsing procedures, ore concentrate dusts have been transported up to 2.5 miles (4 kilometers) from the Red Dog Mine haul road and low levels much farther (Hasselbach et al. 2005; Neitlich et al. 2017). Concentrations of fugitive dust deposition composed of lead have been found to be greatest approximately 33 feet (10 meters) from the road (Hasselbach et al. 2005) but could occur within 328 feet (100 meters) from the road (Ford and Hasselbach 2001). However, heavy metal dust has also been shown to impact vegetation well beyond 328 feet (100 meters), although impacts decrease logarithmically with distance (Neitlich et al. 2017). Heavy metal dust can persist in the soil for many decades (Neitlich et al. 2017), resulting in impacts to the surrounding vegetation and habitat. The effects from ore dust to vegetation include lichen mortality, decreased lichen species richness and cover, decreased moss cover, and degradation of moss species (Neitlich et al. 2017), which could result in degradation and changes to vegetation community composition. Appendix N has potential mitigation measures that would require AIDEA to submit and follow approved dust-limiting plans.

Degradation of water quality due to construction and operations could also result in impacts to vegetation. Impacts to vegetation would likely be greatest within floodplains and riparian zones. Similarly, effects to vegetation may also affect related resources such as water quality and hydrology (see Section 3.2.5, Water Resources).

Other factors that could affect vegetation near the road include the introduction of toxicants. Introduction of toxicants from dust suppressants containing chloride and petroleum products associated with vehicle use and roadway water runoff can impact vegetation. In addition, construction and operation activities that cause any disturbance to vegetation and soil surface layers would increase the vulnerability of these areas to the establishment of NNIS, which, once introduced, have the potential to expand beyond initial disturbance footprints. See the NNIS discussion below.

Impacts to vegetation can be partially mitigated through stabilization and revegetation of soils within construction zones and along the road fill slopes, dust suppression, and adhering to BMPs during construction and operations. As a design feature, AIDEA has proposed to work with the Alaska Plant Material Center and the relevant land manager to develop a plan for obtaining native plant seed and cuttings to be used for restoration and reclamation needs (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Appendix N provides additional details of potential measures to reduce impacts. If Appendix N measures are applied in addition to AIDEA's design features, revegetation of soils can be successful. However, such measures would not reduce the permanent loss to vegetation or the loss in plant diversity. Changes to vegetation due to altered hydrology, compacted soils, and the introduction of toxicants from dust deposition and dust suppressants would remain. Potential measures to prevent the introduction and spread of NNIS include regular monitoring and eradication measures, which are likely to slow the procession of NNIS but not prevent it.

Seasonal ice roads and trails are proposed during construction Phase 1. Impacts to vegetation from ice roads include soil compaction, alterations to drainage patterns, and physical damage to aboveground plant structures (Guyer and Keating 2005). Risk of damage varies among vegetation types where forest and tussock shrub types are more susceptible to damage to aboveground plants structures and seasonally flooded or flooded wetlands have the fewest impacts (Guyer and Keating 2005).

Wetland Impacts

Construction, operation, and road closure and reclamation activities that would impact wetlands include those activities mentioned above in the Vegetation subsection. The primary effects to wetlands from these activities would be the direct and permanent loss of wetlands and wetland function from the discharge of fill and the degradation of wetlands and wetland function through indirect impacts (e.g., dust deposition). Direct impacts were considered to occur within the project footprint and a surrounding 10-foot buffer. The indirect effects shadow area was considered to be within a 328-foot (100-meter) buffer surrounding the footprint boundaries. The comparative analysis among alternatives as discussed in this section, was done considering the maximum possible direct and indirect impacts as described for Phase 3 of the project. Appendix E, Tables 11 through 13, show the calculated acreages of impact to wetlands within the construction limits, the 10-foot construction buffer, and a dust impacts buffer for Alternatives A, B, and C, to illustrate the magnitude of loss and degradation.

The discharge of fill for the construction of the road and facilities pads constitutes the direct impacts to wetlands resulting in the permanent loss of functions. Overall impacts from fill placement would be reduced through the use of best management practices incorporated into the road design, and avoided by routing the road around unique or especially high-value wetlands and locating the road in higher elevation upland terrain where feasible. Special conditions under the USACE Section 404 permit required to avoid and minimize impacts to WOTUS have been adopted in this Draft Supplemental EIS as proposed mitigation measures and can be found in Appendix N, Section 3.5.

Stream and wetland drainage features are ubiquitous along all proposed alternative corridors with 2,883, 3,164, and 4,348 culverts proposed for Alternatives A, B, and C, respectively (see Appendix E, Table 14). Most culverts would impact upper and lower perennial flowing waters, but culverts would also impact PSS wetlands that are typically found adjacent to streams and riverine features. While the roadway could disrupt natural hydrology, the project's design features would mitigate many of these impacts (see Section 2.4.4, Design Features Proposed by AIDEA). AIDEA would incorporate design features intended to minimize or mitigate impacts to vegetation and wetlands. Additionally, the 2020 JROD and USACE Section 404 wetland permit special conditions, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), specify measures the project would undertake to minimize or

mitigate impacts to wetlands, including the Nutuvukti Fen, and natural drainage flow, hydrology, stream continuity, and fish passage.

Proposed wetland avoidance and minimization strategies include reducing road widths, reducing the number of material sites, implementing BMPs for construction in thaw-sensitive soils, using fugitive dust controls, and including upstream floodplain protections for the Nutuvukti Fen. Functional comparison of the alternatives was completed on the basis that wetlands within the analysis area are not degraded (i.e., fully functioning) and each alternative would impact similar wetland types with similar functions, and thus a functional assessment was not completed for all action alternatives.

Fugitive dust from road operation has the potential to indirectly impact wetlands within a 328-foot (100-meter) buffer surrounding the direct impact zone. Primary impacts would result in a reduction of non-vascular biomass and diversity and potentially a change in the composition of vascular plants (Auerbach et al. 1997). Wetland types with the highest diversity of non-vascular plants include PFO and some of the saturated PEM types that are characterized by thick moss peat layers important specifically in the maintenance of soil thermal regimes. Degradation of the vascular flora in wetlands may also have an adverse effect on the bird and mammal habitat suitability function for both PFO and PEM wetlands. conditions to the USACE Section 404 permit, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), addressing impacts from fugitive dust, include measures 22 and 23, which regulate dust reduction best practices, such as restricting the use of chemical dust palliatives.

Most wetlands within the project area are PFO or forested slope wetlands found along the lower mountain slopes adjacent to drainages and floodplains. PFO wetlands are rated high for maintenance of soil thermal regime and typically occurs in continuous permafrost along the Alternative A and B alignments. Melting permafrost at the edges of the roadway may by triggered by impoundment of groundwater discharge, which could expand erosion well outside of the direct footprint area. USACE special conditions 13 through 15, which the BLM has adopted as proposed mitigation measures (see Appendix N, address the potential for indirect erosional effects from permafrost melt by specifying deeper fill thicknesses and possible insulation be used in thaw-sensitive areas. Any flow of surface water upslope of the road would be redirected to the nearest culvert location. To some extent, the fugitive dust control measures discussed above would also mitigate against thermokarst erosion by preserving the health and thickness of the insulating organic layer in PFO wetlands adjacent to the project.

The introduction of NNIS and chemical toxins through placement of fill is a risk for indirect impacts throughout the project area. As noted above, NNIS infestations have been documented throughout the region, and some invasive plants are expected to be introduced into the system with the construction and operation of the road. NNIS plants have the potential to degrade wetlands and reduce function by altering the plant community composition and outcompeting native plants. Infestations of invasive plants are typically characterized by a reduction in species diversity, which could impact several wetland functions, including maintenance of the soil thermal regime and bird and mammal habitat suitability. Minimizing the introduction of NNIS species into the area would primarily be controlled by the project proponent has committed to using clean fill and avoiding discharging excavated materials (i.e., snow or dirt) containing seeds or vegetation into wetlands through snow removal practices. Site restoration is also covered under special condition 21, which the BLM has adopted as a proposed mitigation measure (see Appendix N) and specifies the use of clean topsoil and native seed in revegetation and erosion control operations. In addition, AIDEA would prepare an Invasive Species Prevention and Management Plan (ISPMP) to prevent the introduction and spread of NNIS (see Appendix N, Section 3.3.1.3, Non-Native Invasive Species).

The Nutuvukti Fen has been characterized as a unique wetland and is under NPS management. The Alternative A road alignment would cross a glacial outwash moraine that is critical to the maintenance of

the fen and its function. Inadequate drainage structures along the road within the moraine could disrupt the recharge of the Nutuvukti Fen (Speeter 2015; Swanson 1995). Drying of the fen and impoundments of water along the road could hasten permafrost thaw and trigger further erosion as the insulating organic mat thins. The project proponent has committed to avoid the fen and the upgradient moraine through road rerouting, or if impacts to the upgradient moraine are unavoidable, to minimize the disruption of shallow subsurface flow through the moraine as much as possible though the use of appropriate construction techniques (such as a porous road prism).

Trenching to place buried cable or the construction of ditches, if not constructed or restored appropriately, has the potential for indirect adverse effects to wetlands where upslope wetlands are drained through diversion of surface or subsurface waters. The effect of poorly conducted trenching could be the channelization of runoff and associated thermal degradation of underlying permafrost and subsidence, as well as associated drying of drained wetlands. The project proponent has committed to trenching best management practices, such as backfilling to pre-disturbance elevations, revegetation and stabilization, that would minimize impacts to wetlands and natural drainage patterns. Additionally, restoration of disturbed soils and wetlands would be required to reduce impacts to wetlands from construction activities (see the BLM's adopted mitigation measure from the Corps Special Condition 21 in Appendix N).

Unauthorized use of the constructed road may occur under all alternatives, which would include smaller personal vehicles or ORV traffic from local communities. Impacts could include increased erosion at access points or fugitive dust created from vehicle traffic. However, unauthorized use impacts are likely to be very localized, short in duration, and infrequent in occurrence and would not appreciably increase the adverse effects caused by road construction and normal road operations.

Rare Plants Impacts

Rare plant populations could be impacted by all actions throughout project construction, operations and closure as described in the Vegetation Impacts section. If known rare plant populations occur within the project footprint the impacts would be permanent. The analysis in this section is based on Phase 3 impacts, which represent maximum disturbance potential to rare plants due to it having a larger footprint, higher traffic volumes, and longer duration than Phases 1 and 2. Comprehensive surveys have not been conducted along any of the routes of the action alternatives; therefore, the magnitude and context of potential loss or alteration of rare plant species specific to each action alternative are not precisely known[15]. Inferences can be made on the likelihood of rare plant occurrences by comparing preferred habitat availability along each alternative route for the plants that are known to occur in the 50-mile buffer surrounding the footprints.

Appendix N (Potential Mitigation) provides potential measures to minimize impacts to rare plants. Potential measures to minimize impacts to rare plants include preconstruction surveys and appropriate engineering and design measures to avoid direct impacts where possible.

Non-native Invasive Plant Species Impacts

The spread and establishment of NNIS along all the action alternatives is considered likely. Impacts to the surrounding area from the introduction and spread of NNIS, including alteration to vegetation and wetland communities, would be long-term. The analysis in this section is based on Phase 3, which

[15]Scoping comments did not identify impacts to rare plants as a significant issue. Based on the rare plants known to inhabit the study area, and the habitat information that is available based on vegetation and other mapping, the BLM determined there is sufficient information to make a reasoned choice among alternatives. Comprehensive surveys on routes totaling more than 540 miles would be exorbitant.

represents the maximum potential for introduction of NNIS over time due to it having higher traffic volumes and longer duration than Phases 1 and 2.

The introduction and spread of NNIS would occur continuously throughout the project's construction, operations and closure. If commitments by AIDEA in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and potential mitigation measures in Appendix N were consistently applied along the proposed alignment, NNIS infestations may remain localized and small enough to be eradicated during seasonal monitoring and removal efforts. The introduction and spread of NNIS is anticipated to be minimized through ROW stipulations, permit requirements, and construction and operations BMPs (BLM 2016a). Road closure and reclamation would result in an increased likelihood of NNIS spread the from the exposure and reseeding of soils.

Because the action alternatives connect to the Dalton Highway, which has large densities of NNIS, it is likely that without adequate mitigation, over time the alternatives would result in similarly high densities of NNIS along them (see also Volume 4, Map 3-11). Volume 4, Map 3-15, depicts those watersheds intersected by the action alternatives that would have a high vulnerability to NNIS infestations due to the proximity of the alternatives to known high density infestations of NNIS on the Dalton Highway. NNIS infestations, if not prevented or eradicated when established, could result in alteration to native vegetation, including wetland vegetation and plant community composition, by increasing competition and reducing species diversity. NNIS establishment could also result in degradation of wildlife and fish habitat, degradation or reduction of subsistence food, and degradation of visual resources.

The spread of *Elodea* could result in alteration of freshwater ecology, alteration of hydrology, and degradation of recreational resources, and could have potentially strong effects on high-value aquatic resources (i.e., salmon and fish-bearing waterways; Carlson et al. 2016). *Elodea* has the potential to degrade fish habitat and displace native flora and fauna; make boat travel difficult; reduce recreation opportunities; and alter freshwater habitats by decreasing water flow and increasing sedimentation. *Elodea* is known to establish via small fragments and can easily attach to equipment, vehicles, boats, and float planes, and therefore has the potential to spread readily (Carlson et al. 2016; Morton 2016; Larsen 2020, Fairbanks Elodea Steering Committee 2017). Once introduced, it spreads easily because broken plant segments form new plants and it can survive when frozen in ice, thereby allowing it to spread long distances downstream (ADNR 2019). As such, there is a potential that contaminated construction equipment during in-water work, such as bridge and culvert installation, could spread *Elodea* into waterways or other aquatic habitat (State of California 2008). The ADNR, Division of Agriculture, recommends removing all visible mud, plants, and fish/animals from equipment to help stop the spread (ADNR 2019). Additionally, GAAR visitors and personnel could pose a risk of spread via gear and equipment brought into the park (e.g., boats, floatplanes, fishing gear). The impacts from the spread of *Elodea* to these affected resources would be considered long term. Appendix N (Section 3.3.1) provides details of potential measures to minimize the impact of NNIS, including *Elodea.*

Impacts from the spread of NNIS could be minimized through baseline and periodic surveys as well as implementation of the ISPMP that would include vehicle cleaning and ongoing monitoring and eradication efforts (see Appendix N).

Wildfire Ecology and Management Impacts

Impacts to wildfire ecology and management within the project area would occur from construction, O&M, and road closure and reclamation of the road and ancillary sites. Development of the action alternatives through a largely undeveloped and wildfire-driven environment would have long-term impacts to the natural wildfire ecology and to wildfire management. Much of the analysis in this section focuses on Phase 3, which represents the greatest potential for alteration of the natural fire regime and

wildfire management due to it having a larger footprint, higher traffic volumes, and longer duration than Phases 1 and 2. Construction impacts would occur during the time each phase is being built. Road closure and reclamation impacts are expected to be similar to those related to construction.

The road would create a large, linear, fire break (typically 100 feet as proposed by AIDEA [DOWL 2019a]) across the land, which could prevent the natural spread of some wildfires, particularly wildfires that are small or burning under wet, damp, or low wind conditions; it would have less of an impact on wildfires burning under hot, dry, and windy conditions. A linear feature would remain on the landscape after road closure and reclamation for a number of years or even decades as native vegetation communities become reestablished. Construction and operation activities could also result in an increase in wildfire frequency due to human-caused ignition of wildfires. An increase in human-caused wildfires, combined with an increase in suppression, could result in more frequent small wildfires occurring near the action alternatives. Additionally, an increase in suppression near infrastructure combined with smaller fires from the road's fuel break effect could result in a delay of fire return intervals and a buildup of fuels near the project, which could result in more intense and severe wildfires during hot, dry conditions in these areas.

Impacts to this cycle could result in preventing natural patterns of vegetation change at the regional level and in turn affect fish and wildlife habitat. Increased wildfire suppression near infrastructure could ultimately lead to more large and severe wildfires in the project area due to increased fuel loading (Danahy 2013; Steel et al. 2015). Further, burning of organic soils during these larger more severe wildfires could accelerate permafrost degradation, whenever all or nearly all the organic layer is burned (Yoshikawa et al. 2002), which could ultimately result in an increase in thermokarst, large-scale slope failures, and long-term changes to the ecology of the area. The construction and operation of roads and ancillary sites could result in long-term changes to the natural fire regime of the project area from increased human-caused fires, prevention of natural fire spread, and increased fire suppression efforts (DOI 2017).

The construction and operations of the road and ancillary sites through a largely undeveloped environment could result in both short- and long-term changes to wildfire management. Current suppression and monitoring efforts in the project area are supported by aircraft and at times, remote staging locations. government access to the road would be anticipated for fire suppression and management activities, such as mobilizing personnel and equipment, which would improve access to suppress wildfires. The road could further improve fire suppression by providing a break in fuels, which could obstruct wildfires.

Forestry and timber impacts from the project clearing would be addressed using responsible land management measures pertaining to the use and sale of timber on BLM-managed lands. Wildfire impacts would be reduced by employing preventative measures described in Firewise Alaska and by such measures as promptly notifying land managers if a wildfire occurs on or near lands subject to the land use authorizations. Appendix N provides additional details regarding this potential mitigation. These measures are designed to establish appropriate protocols for forestry, timber, and wildfire issues for the construction and operation of the road. They would not completely mitigate the impacts but would be effective in reducing the impacts caused by the construction and establishment of a road and associated facilities.

Alternative A Impacts

Vegetation Impacts

The greatest impacts on vegetation under Alternative A would be to upland low and tall shrub, followed by upland mesic spruce forest, which are the most common vegetation types in the project area encompassing 1,897.6 and 1,336.8 acres of the footprint, respectively, or 41.9 and 29.5 percent of the footprint area). The fewest impacts would be to riparian forest and shrub, sedge/herbaceous, and alpine and arctic tussock tundra (direct impacts to 115.5, 136.6, and 130.8 acres, respectively, or individually under 3 percent of the footprint area), which are some of the least common vegetation types in the project area (see Appendix E, Table 8). Similar proportions of impacts to wetlands would occur within the 10-foot construction buffer zone and the 328-foot (100 meter) dust shadow zone. Alternative A has the smallest development footprint of all action alternatives, resulting in the fewest direct and indirect impacts to vegetation.

Wetlands Impacts

The greatest impact to wetlands under Alternative A would be to PSS, followed by PFO wetlands, which are the most common wetland types in the project area. The impacts to PSS wetlands would be roughly twice the impacts to PFO wetlands encompassing 1,341.0 and 601.4 acres in the footprint, respectively (see Appendix E, Table 11). PEM wetlands encompass 116.3 acres, or 2.6 percent, of the footprint area but likely include some higher value flooded wetlands that provide valuable fish and wildlife habitat. Alternative A is the only alternative that could result in impacts to the Nutuvukti Fen, a rare, patterned fen, located approximately 0.25 mile downgradient of the development footprint within GAAR (see Volume 4, Map 3-09B, illustrates location and potential extent of impact).

Rare Plants

Yukon aster was recorded at one location within the footprint of Alternative A (ACCS 2023), which, if present at the time of construction, would result in a permanent impact to that individual or local population. Several additional records of this species are located within the project area but outside the area anticipated to be directly affected (more than 0.25 mile away; Map 3-10). The majority of the known collections of Yukon aster within the 50-mile buffer area are located along the North Fork of the Koyukuk River roughly centered around Evansville. The preferred habitat of Yukon aster are silty, muddy lake and riverbanks sometimes preferring higher salinity (ACCS 2023). Other areas of potential concern based on specific habitat availability would be at the major river crossings including the Alatna, Kobuk, Red, Mauneluk and Kogoluktuk River crossings where targeted surveys could be conducted prior to construction.

Kokrine's sedge (BLM Sensitive plant) and the 6 species from the BLM watch list found within the 50-mile rare plant buffer zone are known to occur at greater distances from the direct impact zone and primarily occur in arctic and alpine habitats which are not commonly encountered along the Alternative A route.

Hudson Bay sedge and thinleaf cottonsedge, state ranked S3 and S2/S3 respectively (Table 6) occur within 0.25 miles of the Alternative A alignment. Both species are wetland obligates with wet meadow, marsh and bog preferred habitats. Both species are likely to occur throughout the direct and indirect impact zones which could be determined with the recommended pre-construction surveys.

Non-native Invasive Species Impacts

Alternative A is the shortest in linear miles of all action alternatives and therefore may present less impact from NNIS introduction and establishment than the other action alternatives. Alternative A crosses two rivers on the eastern portion of the routes that are considered susceptible to *Elodea* infestations. Potential for *Elodea* infestation along these rivers would greatly increase from the construction and operation of Alternative A; however, this alternative would cross fewer susceptible rivers than Alternative C.

Wildfire Ecology and Management Impacts

Many factors could influence wildfire ecology, including vegetation type, moisture content, weather, etc. However, overall length of road that would be developed and the number of structures that would be constructed requiring fire suppression (e.g., maintenance station, communication towers) were used for comparison of impacts among the action alternatives. The length of road that would be developed under Alternative A would be slightly less than Alternative B. The number of structures under Alternative A that would require fire suppression as well as the level of human-caused wildfire occurrence, suppression efforts, and changes to fire management actions are expected to be similar to Alternative B.

Alternative B Impacts

Vegetation Impacts

The most impacts on vegetation under Alternative B would be to the most common vegetation types in the project's footprint: upland low and tall shrub and upland mesic spruce forest encompassing 2,127.4 and 1,622.8 acres, or 41.4 and 31.6 percent of the footprint, respectively). The fewest impacts would be to the least common vegetation types alpine and arctic tussock tundra and sedge/herbaceous (encompassing 146.3 and 125.9 acres, or 2.8 and 2.5 percent of the footprint, respectively; see Appendix E, Table 8).

The development footprint of Alternative B would be slightly larger than Alternative A and would result in more impacts to vegetation. However, the overall distribution of impacts to vegetation community types would be similar between the 2 alternatives, with the exception that Alternative B would impact a larger proportion of upland mesic spruce forest. The impacts across all vegetation types under Alternative B would less than Alternative C, with the exception of greater impacts to upland low and tall shrub (see Appendix E, Tables 9 and 10).

Wetlands Impacts

The most impacts on wetlands under Alternative B would be to PSS and by PFO wetlands encompassing 1,414.5 and 858.1 acres, or 27.5 and 16.7 percent of the footprint, respectively (see Appendix E, Table 12), which are also the most common wetland types in the project area. PEM wetlands lost under Alternative A would total 116.3 acres and under Alternative B, 118.6 total acres would be impacted. The Alternative B route is a longer distance but impacts approximately the same amount of high-value PEM wetlands as Alternative A. Impacts on the Nutuvukti Fen from Alternative B are not anticipated because the fen is located upgradient from Alternative B (see Volume 4, Map 3-09B).

Alternative B would result in slightly greater impacts to wetlands and waterbodies than Alternative A, but less impacts than Alternative C. Overall, Alternative B would have more impacts to PFO wetland types than Alternative A (858.1 acres versus 601.4 acres), which accounts for most of the differences between these alternatives. The amount of impacts to PEM types (typically higher value wetlands, particularly for fish and wildlife habitat services) would be similar to Alternative A, which would be less than half of Alternative C.

Rare Plants

Rare plant impacts under Alternative B are the same as described above under Alternative A.

Non-native Invasive Species Impacts

Alternative B is longer in linear miles than Alternative A but shorter than Alternative C; therefore, the area that would be subject to potential for NNIS introduction and establishment would be greater than Alternative A, but less than Alternative C. Potential for *Elodea* infestation along rivers crossed by Alternative B would be similar to that of Alternative A, but would be less than Alternative C.

Wildfire Ecology and Management Impacts

Impacts specific to Alternative B regarding wildfire ecology and management are discussed above under Alternative A, as these routes are anticipated to have similar effects, which would be less than that of Alternative C.

Alternative C Impacts

Vegetation Impacts

Alternative C would have the largest development footprint of all action alternatives, resulting in the greatest overall amount of impacts on vegetation compared to Alternatives A and B. Similar to Alternatives A and B, most vegetation impacts from Alternative C would be to commonly occurring vegetation types including upland mesic spruce forest, upland low and tall shrub, and riparian forest shrub communities (2,111.4, 1,914.6, and 1,178.2 acres, respectively; see Appendix E, Table 10). Alternative C would affect substantially more riparian forest and shrub compared to the other action alternatives and therefore would affect more river and stream habitat. Alternative C would also have the most impact on other less common vegetation types in the area, including alpine and arctic tussock tundra, emergent herbaceous wetlands, and sedge/herbaceous types.

Wetlands Impacts

Alternative C would result in greater wetland fill and alteration impacts on wetlands than the other action alternatives. The most impact to wetlands from Alternative C would be to PSS wetlands (see Appendix E, Table 13), which is also the most common wetland type in the project area. Alternative C would cross more streams than any other alternative and therefore would have more impacts more riparian wetlands than Alternatives A and B. In addition, Alternative C would impact greater amounts of high-value PEM wetland types than Alternatives A and B combined. Impacts on the Nutuvukti Fen from Alternative C are not anticipated because the fen is located upgradient of Alternative C (see Volume 4, Map 3-09B).

Rare Plants

ACCS rare plant collection locations within the 50-buffer are less common surrounding Alternative C than Alternatives A and B and none occur within the 0.25-mile buffer of the alternative alignment. Alternative C is the longest proposed route which covers a higher proportion of lowland and wetland terrain than the other action alternatives with fewer major river crossings. High quality habitat of Yukon aster is likely to be impacted at the Koyukuk and Kobuk River crossings. The S2/S3 state ranked Hudson Bay sedge and thinleaf cottonsedge may be encountered within wetland terrain along the entire length of the Alternative C route.

Non-native Invasive Species Impacts

Alternative C is longer in linear miles than any other action alternative; therefore, the area that could have the greatest impact from NNIS from introduction and establishment. In addition, Alternative C would cross or travel parallel to more streams and rivers (several of which have been identified as susceptible to *Elodea* infestation) than other action alternatives. As such, Alternative C is considered to have the greatest risk of any of the action alternatives for *Elodea* infestation.

Wildfire Ecology and Management Impacts

Alternative C is longer in linear miles than Alternative A or B with the greatest number of structures that would be constructed requiring fire suppression; therefore, Alternative C is expected to result in the greatest impacts to wildfire ecology and management compared to the other action alternatives. See Alternative A, above.

Combined Phasing Option

The combined phasing option would shorten the construction time period and lessen the construction-related impacts. Initial construction of the road to Phase 2 standards (e.g., increased embankment depth) would reduce indirect impacts to vegetation and wetlands by protecting thaw sensitive permafrost soils, the degradation of which could cause thermokarsting, erosion, and siltation in adjacent wetlands and waterbodies.

<u>Mining, Access, and Other Indirect and Cumulative Impacts</u>

RFAs associated with AIDEA's proposed action that would impact vegetation and wetlands include the advanced mining development scenario, indirect road access scenario, and other actions located throughout the vicinity of the project area (see Appendix H). Ecosystem changes would occur from the combined development of these actions. These actions would result in wetlands and vegetation being lost as a result. Fugitive dust, changes to soil characteristics, changes to hydrology, thawing of permafrost, and increases in NNIS to the area would result in changes to wetlands and vegetation. Associated wetland functions and ecosystem services would also be altered or lost as a result of these projects. Some of these impacts to wetlands and vegetation may not be reversed and would be permanent.

Vegetation, Wetlands, Rare Plants, and Ecosystems and Non-native Invasive Plants

The cumulative effects analysis area for vegetation and wetlands, including NNIS and rare plants and ecosystems, includes the extent of the project area as shown in Volume 4, Maps 3-8 and 3-9.

Indirect impacts to wetlands and vegetation would be expected to occur outside of the 328-foot (100-meter) primary corridor of direct impact, mostly due to changes in hydrology and thermal regime caused by the road structure. These changes would be likely to occur, even with culverts, and would be likely to occur within several years of road construction. To a lesser extent, impacts to wetland function at greater distance also could occur due to NNIS causing changes to the wetland vegetation community. Cumulative impacts in wetland function would be likely since road dust, road infiltration, and embankment erosion are certain to occur along the road and impact natural water chemistry and metals uptake by vegetation, which would go directly into the food chain and decrease aquatic species' ability to use wetlands for habitat. More broadly, Past and present actions that have impacted wetlands and vegetation within this area include (1) construction of the Dalton Highway and other roads and airports in rural Alaska communities, which has resulted in fill within the footprints, alteration beyond the footprints, and the spread and establishment of NNIS near developments; (2) passage of ANILCA, resulting in establishment of the GAAR in the analysis area, which has allowed for the protection of wetlands and vegetation; (3) wildfires; (4) wildfire suppression; and (5) effects from climate change. Due to the observed rapid

warming in Alaska, the rate of permafrost degradation has been increasing, resulting in changes to wetland and upland vegetation types underlain by it. Wildfires have also increased over the past decades. However, for the majority of the project area, wildfires have had limited suppression, which has been mostly focused on communities in the area. Rare plants and ecosystems have been subjected to the same impact conditions as wetlands and vegetation, acknowledging that these resources are less abundant spatially (past and present information on rare plants and ecosystems is limited).

Of all RFAs, mining and its associated activities have the potential to cause the greatest indirect impacts to wetlands and vegetation in the area. Under the anticipated mining scenario, 4 large-scale mines would be developed to extract minerals such as copper, lead, zinc, silver, gold, cobalt, and molybdenum. Open pit and underground mining would result in loss of vegetation and wetlands within development footprints, and alteration of vegetation and wetlands beyond development footprints from disturbance of surface and groundwater flow, lowering of the water table from dewatering activities, and fugitive dust. The exact number of acres of vegetation and wetlands that would be lost or altered is unknown because specific mine proposals have not been made. However, the potential magnitude of impact and alteration is anticipated to be in the thousands of acres, not including accessory roads. In addition, hundreds of thousands of acres of mining claims exist in the advanced mining scenario, which could result in more loss and alteration than initially predicted if more claims are developed. Additional mining claims exist outside of the District, which could also be developed, although less likely. Impacts to wetlands within mine footprints would be considered permanent impacts; however, vegetation may be reestablished in some areas over time, due to expected reclamation requirements, although it is unlikely vegetation would be able to recover to its pre-development condition. Revegetation would not be possible at all locations as some mine-created pit lakes, tailing impoundments, and some concrete foundations would remain permanent fixtures.

The Red Dog Mine has shown fugitive dust from heavy metals can travel thousands of feet to several kilometers in distance, particularly if strict mitigation measures are not employed or practiced. This can result in increased or complete loss of lichen and moss (Neitlich et al. 2017). Heavy metal dust can persist in the soil for many decades (Neitlich et al. 2017), resulting in adverse impacts to the surrounding vegetation and habitat. Additionally, mosses, lichen, and vegetation can accumulate heavy metals in their tissue (Brumbaugh et al. 2011; Ford and Hasselbach 2001; Wegrzyn et al. 2016), which could have impacts to overall vegetation health and could pose risks to wildlife, fish, and subsistence users as these metals enter the food chain.

Fugitive dust impacts would occur around the mine footprints from vehicle traffic, blasting, material loading, ore stockpiles, crushing activities, waste piles, and exposed mill tailings (ABR 2007), as well as along the entire truck haul route along the Dalton Highway to Fairbanks. Spills of ore concentrate due to trucking accidents and inadequately sealed ore containers could result in further contamination. In addition, tailings and settling ponds associated with the mines could potentially lead to contamination of surface water and groundwater, leading to pollution and other impacts to vegetation, wetlands, and other aquatic resources (Woody et al. 2010). The development of these mines and accessory roads would also result in an increased risk of spread and establishment of NNIS in the surrounding environment, which could alter vegetation and wetland community composition. Rare plants and ecosystems would be subjected to the same impact conditions from mine development as wetlands and vegetation.

The commercial access scenario (see Appendix H, Section 2.2.1, Commercial Access Scenario) would allow for community access to AIDEA's proposed action for the commercial deliveries to communities. Routes and roads established off AIDEA's proposed road as well as the increase in traffic from commercial goods is expected to increase the spread of NNIS. The development of community roads or routes to AIDEA's proposed action could result in the loss or alteration in vegetation and wetlands,

especially if permanent roads are built. In addition, impacts to rare plants and ecosystem types, such as geothermal springs, could occur due to increased human access to the locations near them.

Although the road would not be open to the general public by design, public use and trespass are expected to occur (see Appendix H, Sections 2.2.2, Public and Non-Industrial Access, and 2.2.3, Trespass Scenario, for details on potential changes in road access and use). Local community use of the road is anticipated to primarily come from snowmobiles or OHVs, which may result in an increase in trails leading to or from the road. New trails would impact vegetation and wetlands along their alignments and could include the spread of NNIS or damage to rare plant communities. Should the road be made open to the public (e.g., following mine closure or abandonment), the roadway would likely need improved to meet current DOT&PF public roadway specifications (e.g., curve radii, slope limits), which would expand the road's footprint, directly impacting vegetation and wetlands. Additionally, an increase in traffic from public use would result in increased fugitive dust generation and sediment transport into area waterways. Similarly, any communities with road connections to the Ambler Road that could negotiate access agreements, would increase overall road traffic. As road traffic increases, particularly with public users (versus licensed commercial operators), there would be an increased risk in vehicle accidents and vehicles leaving the roadway, which may result in additional impacts to adjacent vegetation and wetlands from any fuel or chemical spills.

RFAs not associated with AIDEA's proposed action that would impact vegetation and wetlands, including rare plants and ecosystems include Dalton Highway maintenance and improvements and climate change. The further development of the Dalton Highway would likely result in additional fill and alteration of wetlands and vegetation due to expansion. Expansion of the highway may also allow for increased traffic, which could result in more spreading of NNIS from vehicles.

Climate change would continue to result in warming temperatures, permafrost thaw, changes to the fire regime, and changes to fire-driven vegetation succession, which could result in a positive feedback loop that further accelerate changes to the ecology of the area. Climate change can drive permafrost thaw and deepening of the active layer, which can result in thermokarst impacts. Areas adjacent to thermokarst impacts could drain, which could result in a conversion of wetland and upland communities. Early snowmelt from rising global temperatures can also lead to decreased albedo, which could also result in drier lands or smaller waterbodies (USACE 2018). Climate change is also resulting in reduction in the size of lakes and ponds, conversion of wetland types, alteration of plant composition, loss of lichen habitat, and increased wildfires (EPA 2017). Research has shown that climate change related factors are contributing to an increase in shrub expansion, increased tall shrub biomass in some locations, and alteration to tundra structure and function (Myers-Smith et al. 2011). Climate change has also been shown to create favorable conditions for the establishment of NNIS due to climate change induced stress in ecosystems creating pathways of invasion (Masters and Norgrove 2010). Thus, climate change would be expected to intensify and accelerate any human-caused changes to the project area resulting from the reasonably foreseeable developments associated with AIDEA's proposed action.

The cumulative effects from mine development, indirect road access, AIDEA's proposed action, as well as other reasonably foreseeable developments would compound the magnitude of all previously discussed impacts. Cumulative effects would occur from the combined impacts of these projects. Thousands of acres of wetlands and vegetation would be impacted by these projects. Alteration to wetlands and vegetation from fugitive dust, changes to soil characteristics, changes to hydrology, thawing of permafrost, and increases in NNIS to the area would result in widespread changes to wetlands and vegetation across the project area from these projects, which would be further compounded by the effects of climate change. Associated wetland functions and ecosystem services could also be lost or altered due to the development of these projects. The development and operation of mines and AIDEA's proposed

action could result in contamination to surrounding environment due to fugitive dust from trucks hauling ore or spills from trucking accidents, leading to further loss or alteration of vegetation and wetlands. The loss or alteration of rare or high-value wetland types combined with climate change-induced changes to wetlands could degrade and reduce them from the area. These projects would also result in loss and alteration of tundra types, which are uncommon in the project area, which could also be further impacted by climate change-induced affects and could increase the introduction and spread of NNIS. Some of these impacts to wetlands and vegetation would be permanent, forever changing the project area. As such, the impact on vegetation and wetlands from AIDEA's proposed action, reasonably foreseeable future actions, and ongoing climate change is expected to have substantial cumulative and long-term impacts to wetlands and vegetation, including rare plants and ecosystems. While the indirect mining impacts would be similar, cumulative impacts to wetlands and vegetation would be greatest from Alternative C because it would result in greater impacts to wetlands and vegetation than Alternatives A and B. In addition, Alternative C is the longest road alignment among the alternatives, which would potentially allow NNIS to spread over a greater distance, however the impacts would not be concentrated in a single ecoregion like Alternatives A and B.

Wildfire Ecology and Management

The cumulative effects analysis area for wildfire ecology and management includes the extent of the project area as shown in Volume 4, Map 3-14.

Past and present actions that have impacted wildfire ecology and management within this area include construction of the Dalton Highway and development of roads and airports in rural Alaska communities, which have resulted in an increase in human-caused wildfires and changes to the natural fire regime. Climate change has also resulted in increased wildfire activity in the area (BLM 2018b). Wildfires have also become more prevalent in tundra vegetation types where, historically, wildfires were less frequent and smaller (BLM 2018b; Joly et al. 2012). Warmer temperatures in Alaska caused by climate change have created earlier dry conditions for fuels to burn and longer fire seasons. For the majority of the project area, wildfires have had limited suppression, which has been mostly focused on communities in the area. Most of the acreage burned in the area are from lightning-caused fires, which are a part of the natural ecology of the area and is a primary driver of succession in boreal forest (Joly et al. 2012). Human-caused wildfires are less common in the area and tend to be smaller, due to suppression, and generally localized to the areas with communities and roads (BLM 2016).

RFAs that may affect wildfire ecology and management within the analysis area include the advanced mining development scenario, commercial access scenario, potential public and non-industrial access, and other actions throughout the vicinity of the project area.

Mining and its associated activities have the potential to cause an increase in both more frequent human-caused wildfires and wildfire suppression. Once mine infrastructure and associated accessory roads are in place, there would be a shift in fire management in these areas from Modified[16] and Limited management to Critical or Full to protect human life, property, and infrastructure. The likely increase in human-caused fires would contribute to further alteration of the natural fire regime.

The commercial access scenario (see Appendix H, Section 2.2.1, Commercial Access Scenario) would allow for community access to AIDEA's proposed action for the purpose of delivery of commercial goods. Additionally, public access (lawful and trespass) could occur over the life of the road (see Appendix H, Sections 2.2.2, Public and Non-Industrial Access, and 2.2.3, Trespass Scenario, for details

[16] Federal and state agencies, in cooperation with Alaska Native entities, employ 4 wildfire management options: Critical, Full, Modified, and Limited (AICC 2019).

on potential changes in road access and use). The construction of local roads or trails connecting to the Ambler Road or illegal use of the road from trespassers would likely increase the occurrence of human-caused wildfires due to increased human activity in the area. Human-caused wildfires in these areas may lead to more suppression efforts, depending on the jurisdictional agency managing the resource where the wildfires occur. Although many of these communities generally have Critical management options, surrounded by Full management, then further surrounded by Modified options, the addition of community roads or routes could potentially extend some of these higher protection management options. In addition, federal agencies generally extinguish wildfires that do not start naturally on federal lands due to policy and land management plan objectives, which could lead to increased suppression efforts and could contribute to changes to the area's natural fire regime. Actual suppression efforts would be determined by the respective jurisdictional agency managing a wildfire on non-federal lands.

RFAs not associated with AIDEA's proposed action that could impact wildfire ecology and management include improvements made along the Dalton Highway, Arctic oil development, and climate change. The further development of the Dalton Highway and Arctic oil development would likely result in an increase Dalton Highway traffic volumes, which in turn could result in increased wildfires and suppression efforts.

Climate change could result in changes to the area's land and ecology, as discussed above. Alaska fire records indicate that large wildfires are becoming more frequent (BLM 2018b). Climate change is also expected to increase frequency, size, and severity of wildfires (EPA 2017). Burning of organic soils during wildfires has been shown to accelerate permafrost degradation, particularly during severe fires where all or nearly all of the organic layer is burned (Yoshikawa et al. 2002). After wildfires, soils have been found to be warmer and have a drier moisture regime for many years to decades (Harden et al. 2006; Yoshikawa et al. 2002). Yoshikawa et al. (2002) also found reductions to surface albedo, post-fire. The natural ecology of the area, which drives vegetation composition and successional stage, could be altered as a result of an increase in wildfires and an increase in their severity. More frequent and severe wildfires would increase permafrost thaw and result in expansion of thermokarst bogs (Gibson et al. 2018). Under climate warming conditions, summers are predicted to be warmer and drier, which is expected to increase the amount of boreal forest and tundra vegetation burned (Joly et al. 2012). However, it should be noted that future precipitation regime changes and the associated effects on wildfire regimes are difficult to predict (AMS 2016). According to Joly et al. (2012), this could have severe impacts to lichen tundra types, as lichen can take a long time to recover. Wildfire can also impact riverine wetlands and aquatic habitats by causing increased stream temperatures and increased nutrient loading, erosion, and sedimentation in streams. Additionally, increased wildfire activity is expected to further increase NNIS invasions (Carlson et al. 2016).

The cumulative effects from development of mines, indirect road access, AIDEA's proposed action, as well as other reasonably foreseeable developments would compound the magnitude of all previously discussed impacts. Impacts from these actions would include an increase in the number wildfires, changes in the natural fire regime, change in the natural wildfire ecology of the area, increased wildfire suppression, and changes to fire suppression management options. The number of wildfires would increase due to more human-caused wildfires and more natural lightning-caused due to warmer temperatures and longer fires seasons. Wildfire suppression would be increased in areas surrounding the proposed action. The greater length of Alternative C could result in more frequent or more severe wildfires compared to Alternatives A and B. More wildfires would emit additional GHGs and add to climate change impacts, creating a positive feedback of events in the environment, including further degradation of permafrost, wetlands, and vegetation.

More severe wildfires resulting from increased fire suppression combined with climate change factors could also impact riverine wetlands and aquatic habitats. Vegetation composition in the area is driven by

wildfire and would be greatly impacted by the compounding effects of changes to the natural fire regime from development and climate change. Tundra vegetation types, including alpine and arctic tussock tundra and alpine dwarf shrub tundra, are less common in the project area and as such, may have the greatest impacts from cumulative effects of changes to wildfire ecology.

Mitigation measures such as fuel reduction efforts, controlled burn activities, and fast response fire suppression actions would not eliminate wildfire changes but may minimize the occurrence and severity of anticipated wildfire changes associated with future mine development projects or other RFAs. These measures may require federal appropriations or funding commitments through permitting to occur.

3.3.2 Fish and Aquatics*

Affected Environment

The study area for fish includes large and small rivers, tributary streams, lakes, and other aquatic habitats within drainage basins[17] intersected by the project alternatives (see Volume 4, Map 3-06 and 3-17). Within the Kobuk-Selawik River basin, these include major rivers such as the Kobuk, Reed, Mauneluk, Kogoluktuk, and Shungnak rivers and Beaver Creek. These rivers in the western portion of the study area generally flow west and drain into Kotzebue Sound in Northwest Alaska via the Kobuk River. Major rivers in the eastern portion of the study area include the Koyukuk, Wild, John, Malamute Fork of the Alatna, Alatna, Indian, and Hogatza rivers and Hughes Creek in the Koyukuk River basin, and the Melozitna and Tozitna rivers in the Yukon River Basin. These rivers generally flow south-southwest and contribute to the lower Yukon River Basin. The Ray and Big Salt rivers[18] drain into the middle Yukon Basin. Fish populations in these streams generally are managed across all land ownerships by the ADF&G. The BLM has relied upon ADF&G's annual Anadromous Waters Catalog (AWC) surveys and G2G consultation as important sources of information on fish distribution in the study area. Habitat in the project area supports fish species integral to the subsistence practices of villages throughout the region (Brown et al. 2012; Anderson 2007; Anderson et al. 2004a; Braem et al. 2015; see Section 3.4.7, Subsistence Uses and Resources, for details). Section 3.2.5, Water Resources, describes water quality and habitat characteristics for streams and lakes in the study area.

Fish

Various research surveys have resulted in documentation of more than 20 fish species in the study area (see Appendix E, Table 15). Pacific salmon, sheefish, broad and humpback whitefish, Arctic grayling, northern pike, and burbot are the major targets of a subsistence, sport, or commercial fishery activity and the focus of this section. See Appendix L as well as Sections 3.4.7, Subsistence Uses and Resources, and 3.4.2, Transportation and Access, for additional information. No fish species listed as threatened or endangered under the ESA occur in the study area and there is no designated critical habitat identified in the study area (Swem 2020).

Aquatic Habitat

Aquatic habitat in the study area supports multiple anadromous and resident fish populations. While several lakes in the study area can support fish year-round (Brown et al. 2012), many anadromous and resident fish migrate seasonally between mainstem, tributary, and connected off-channel habitats[19] to

[17] Alternatives A, B, and C traverse the Koyukuk and Kobuk-Selawik river basins (based on USGS hydrologic unit code's (HUC's) 6th level [HUC6]). Alterative C also traverses streams in the Beaver Creek-Yukon and Melozitna-Yukon river basins (HUC6). The Kobuk-Selawik river basin contributes to the Northwest Alaska basin (HUC8); the rest contribute to the Yukon Basin (HUC8).

[18] The Ray and Salt river drainages are in the Beaver Creek-Yukon River basin (HUC6).

[19] ABR (2014) describes physical habitat conditions for 11 streams along the northern portion of the study area and discusses potential habitat functions (e.g., spawning, rearing) at each site.

access preferred feeding, rearing, spawning, or overwintering areas (Brown 2009; Savereide and Huang 2016; Wuttig et al. 2015). The mainstem channels of major rivers generally provide overwintering habitat for mixed stocks of several species and serve as a corridor between seasonal habitats (Wuttig et al. 2015). Maintaining seasonal habitat connectivity is critically important for many fish species in the study area (Brown et al. 2012; Wuttig et al. 2015).

Fish distribution presented here (see Volume 4, Maps 3-17 and 3-18) represents the best available data to date. However, fish more than likely use other habitats in the study area, including streams, rivers, lakes, and off-channel areas, that may be of equal or potentially more import than those discussed here (Brown et al. 2012; Larson et al. 2017; Wuttig et al. 2015). Additionally, some aquatic habitats that may not currently be important for key fish species may become more important in the future as species and habitats adjust to changing climatic conditions and other factors (Clark et al. 2010). Villages on the Upper Koyukuk suggested that as the salmon fishery declined on the Yukon River, the keystone fish species in the region has shifted to whitefish, sheefish, and grayling (Alatna Village G2G consultation; Allakaket Village G2G consultation). Therefore, all connected aquatic habitats in the study area were considered important to fish in the Supplemental EIS analysis.

The Final EIS (BLM 2020) relied primarily on data from the ADF&G AWC to determine fish habitat represented in Volume 4, Maps 3-17 and 3-18 (Johnson and Blossom 2019a); however, the AWC has known limitations, and many remote site streams within the alignment alternatives have not been assessed for fish spawning and rearing. New anadromous and resident streams have been identified since 2019 as a result of targeted efforts by ADF&G to further identify fish presence in the study area (Bear 2022; Giefer and Blossom 2021; Giefer and Graziano 2022) and the BLM in cooperation with Tribes have identified some additional fisheries through G2G consultation.

Additional field study would be necessary to identify all streams and other aquatic habitats in the study area and to determine potential fish use. In addition to ADF&G surveys, AIDEA has identified stream habitat (fish bearing or not) in the study area using a combination of desktop analyses and field surveys. Densely vegetated habitats precluded identification of some small drainages (less than 12 feet wide) in some areas (DOWL 2014a, 2016b).

Lakes in the region are less common than other regions of Alaska (e.g., NPR-A on the western Alaska coastal plain). Lakes and ponds comprise just over 1 percent of the total project area (see Appendix E, Table 5) (see Volume 4, Map 3-09). Data related to the amount of overwintering fish habitat is sparse. However, for fish-bearing lakes and ponds in the area, these species face a rapidly changing environment. Emerging data on the response of permafrost lakes to climate change (e.g., permafrost thaw resulting in physical and chemical changes to lakes or increased water temperature leading to increased oxygen consumption) and road development (e.g., changes to flooding regime or water quality) indicate that factors such as lake size and water quality are strong drivers of fish community diversity and health (Murdoch et al. 2021).

Pacific Salmon

Quantitative information regarding the strength and run size of salmon stocks are not available for most streams throughout Alaska, including those in the study area (JTC 2019; Larson et al. 2017; Munro 2018; O'Brien 2006). The ADF&G AWC identifies 4 Pacific salmon species in the study area. Chinook and chum salmon are widely distributed; ADF&G studies confirm that at least 1 of these 2 species use all major rivers or streams in the study area along with many tributary streams (Johnson and Blossom 2019a, 2019b). Pacific salmon spawn in summer or fall, and eggs incubate through winter and hatch the following spring. Embryo survival depends on water temperature, substrate conditions, and sufficient water depth throughout incubation. Volume 4, Map 3-17, identifies known Chinook and chum salmon

spawning areas; however, spawning likely occurs in other suitable habitats not yet identified (Brown et al. 2017; Larson et al. 2017). Studies documented juvenile Chinook, coho, and chum salmon,[20] as well as Dolly Varden, in small tributary streams throughout the study area (ABR 2015; ADF&G 2019a; Lemke et al. 2013; Scannell 2015). In addition to small headwater streams and major rivers, salmon and other key fish use off-channel habitats such as wetlands, sloughs, and off-channel ponds (Quinn 2005; Wuttig et al. 2015). Under natural conditions, many important off-channel habitats and some headwater streams may only be available seasonally, during high rainfall or flood events (Quinn 2005; Wuttig et al. 2015).

The South Fork Koyukuk River has historically provided habitat for large numbers of Chinook and chum salmon (BLM 2016a; Larson et al. 2017). Henshaw Creek is especially important spawning habitat for chum salmon in the Koyukuk River drainage. Henshaw Creek, along with the Tozitna River and the South Fork Koyukuk River, also provide major spawning habitat for Chinook salmon in the middle Yukon River basin (Brown et al. 2017). Previous surveys have documented that the Hogatza River and its tributaries can support tens of thousands of chum salmon (Esse and Kretsinger 2009; Kretsinger et al. 1994). Because some years with high water make use of the Henshaw weir unusable, there is a lack of data during these events, although Henshaw Creek is considered important to the rebuilding of Yukon River Chinook and chum salmon stocks.

Salmon production within a stream and throughout a drainage can shift over time. Due in part to the life history cycle of salmonids, a stream may produce relatively few salmon in any given year, usually due to year-class failure brought on by several factors (e.g., incubation failure due to habitat conditions, excessive predation on juveniles, lack of food, ocean conditions). The same stream may provide significantly increased salmon production within a year or two of year-class failure. (Brown et al. 2017; Larson et al. 2017; JTC 2019; McKenna 2015). This is evidenced by long-term annual escapement estimates of summer chum salmon for the Anvik River and Henshaw Creek (McKenna 2015; JTC 2019)[21].

Coho and sockeye salmon distribution appears more limited in the Koyukuk River basin compared to chum and Chinook salmon. ADF&G AWC surveys have not documented coho and sockeye salmon in the western portion of the study area (Johnson and Blossom 2019a). In the Malamute River and Alatna River, coho salmon are present and extend upstream to Mettenpherg Creek. During consultation the Alatna Village Council also identified the Rockybottom Creek, a tributary of the Alatna River, as a coho spawning location. Although the Rockybottom Creek is not directly crossed by the proposed Ambler Road, the creek maybe subject to downstream effects from the Alatna River. In the South Fork Koyukuk River coho salmon extend upstream to the Jim River (Johnson and Blossom 2019b). (Note: Coho salmon are difficult to document during surveys due to their later run timing, often occurring during late summer or fall under high water conditions or under ice). Sockeye salmon use the Koyukuk River upstream to Henshaw Creek (Johnson and Blossom 2019b). See Volume 4, Map 3-17 for known salmon distribution throughout the study area (Brown et al. 2017; Johnson and Blossom 2019a, 2019b; Larson et al. 2017).

The BLM has identified the Tozitna and Indian rivers as having valuable chum and Chinook spawning habitat (Knapman 1989; Kretsinger and Will 1995). More than 42,000 acres in the Clear and Caribou creek watersheds (tributaries to the Hogatza River) provide some of the most productive chum salmon production habitat within the Koyukuk River drainage (BLM 2016a; Kretsinger et al. 1994). Areas along

[20] Chinook, coho, and sockeye salmon young typically rear and overwinter in freshwater systems prior to outmigrating to saltwater, while chum salmon outmigrate soon after emergence.

[21] Escapement estimates for summer chum salmon in the Anvik River, based on sonar counts from 1979 through 2018 have fluctuated between 193,098 fish (in 2009) and 1,479,582 fish (in 1981) (JTC 2019). Escapement estimates for summer chum in Henshaw Creek, based on weir counts from 2000 through 2017, have fluctuated between 21,400 fish (in 2003) and 360,687 fish (in 2017) (JTC 2019; McKenna 2015).

the Hogatza River also contain high-value salmon habitat within Clear, Caribou, and High creeks. Additionally, the BLM (2016a) has identified high-value chum spawning habitat in the Klikhtentotzna River (tributary to upper Hogatza River) and portions of the South Fork Koyukuk River provides habitat for a large number of Chinook and chum salmon.

Most subsistence harvest of adult salmon occurs in July and August when salmon return to study area streams to spawn (Anderson et al. 2004a; Braem et al. 2015). Restrictions on Chinook salmon harvest, due to a substantial decline in their population, initially resulted in increased subsistence and commercial harvest of chum salmon in the Yukon River basin (Larson et al. 2017). However, since publication of the Final EIS (BLM 2020), chum salmon closures have also occurred (see Salmon Declines below). Many Koyukuk River Villages have turned to other fish species like whitefish, sheefish, and grayling in light of the Yukon River salmon declines.

Non-salmon Species

Sheefish, broad whitefish, humpback whitefish[22], and grayling comprise most of the non-salmon subsistence harvest for Koyukuk River and Upper Kobuk communities[23] (Anderson et al. 2004a; Brown et al. 2012; Georgettee and Shiedt 2005; G2G consultation; see Section 3.4.7, Subsistence Uses and Resources). Sheefish, the largest member of the whitefish family, require specialized spawning habitat limited by water temperature, substrate composition, and specific water quality characteristics influenced by geologic features (Alt 1994; Braem et al. 2015; Savereide and Huang 2016) (see Volume 4, Map 3-18). They typically exhibit a high degree of spawning site fidelity, not only to spawning streams but to specific areas within a reach of stream (Savereide and Huang 2016[24]). Sheefish and other whitefish broadcast spawn over mixed-sized gravels in swift flowing water in fall (Gerken 2009), eggs develop over winter, and larvae emerge in spring, with young dispersing downstream typically during spring floods. Spawning areas are used selectively, and large populations may target an area of ideal spawning grounds within a very short river reach (Underwood et al. 1998; Tanner 2008; Gerken 2009). Immature whitefish typically rear in a wide range of habitats for several years before migrating upstream to spawn (Brown 2009).

In the Upper Kobuk River local residents indicate that whitefish move seasonally between the lakes and the river; in the winter and early spring the whitefish will travel to the lakes and sloughs along the Kobuk River Delta and then in the late summer and early fall the whitefish will travel to the Upper Kobuk to spawn (Georgettee and Shiedt 2005). Two Noorvik Elders explained:

> *When the high water goes into the lakes from the river right after break-up, the fish go into the lakes. They follow the water. You know the small lakes and sloughs? They come out right away from there. Sloughs with a lot of lakes in the back, they whitefish start coming out around July 4th (Georgettee and Shiedt 2005: 49).*

Another Elder from Shungnak, Alaska suggested that the whitefish start running when the "cotton flies" from the willows. And the migration is associated with the weather. The two Noorvik Elders suggested that the whitefish know the weather and need the right kind of the wind from the east to migrate (Georgettee and Shiedt 2005). The whitefish then move to the Upper Kobuk to spawn, Upper Kobuk residents begin fishing in swift water and sandbars in the summer and fall when the whitefish spawn. However, the Upper Kobuk residents say the movement of the whitefish is complex and some move in and out of lakes and tributaries of the Kobuk River such as the Shungnak, Kogoluktuk, Mauneluk and

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22 Anadromous forms of sheefish, and broad and humpback whitefish occur in the study area (Brown 2009; Savereide and Huang 2016; Wuttig et al. 2015).
23 Area residents harvest whitefish from rivers and lakes throughout the year (Anderson et al. 2004a; Brown 2009).
24 See Savereide and Huang (2016) for more information on sheefish in the Kobuk River drainage.

Selby Rivers, to Lake Selby, Narvak Lake, and Kolliosak Lake (Georgettee and Shiedt 2005; G2G consultation). The upper Kobuk River also supports "the largest spawning population of sheefish in northwestern Alaska" (Scanlon 2009:7; Taube and Wuttig 1998). The Kobuk River is well known for its world-class sheefish trophy fishing. In the Koyukuk River drainage, the Alatna River is the most important spawning area for sheefish and several other whitefish species (Brown 2009). See Volume 4, Map 3-18,[25] for known sheefish and other whitefish spawning locations. This figure almost certainly underrepresents suitable whitefish habitat in the study area (Brown et al. 2012; Wuttig et al. 2015). The Alatna and Allakaket Village Tribal Councils indicated that maintaining the sheefish and whitefish fisheries on the Alatna River are essential to maintaining subsistence traditions (G2G consultation). Maintaining spawning habitat is critical to the survival of the Kobuk and Yukon rivers sheefish and whitefish populations because a large fraction of any given spawning population may spawn in a small, distinct geographic area. By comparison to spawning habitat, locations suitable for supporting rearing, feeding, and overwintering sheefish (which are also important to other whitefish populations) are more widely distributed across a population's range (Brown 2009; Brown et al. 2012).

Arctic grayling is a widely distributed resident species and a regular target of subsistence harvest efforts. Late Elder Joe Sun of Shungnak recalled the importance of the Ambler, Kogoluktuk, and Mauneluk Rivers for grayling; stating,

> *You can stop anyplace along the way on one of those rivers and fish for grayling..we would have to carry hooks with us to at all times because there's always grayling* (Sun 1983).

Arctic grayling typically move from large river or lake habitat into smaller tributaries to spawn during or just after spring break-up. Young-of-the-year hatch soon after during summer (Stewart et al. 2007). Due to this life history trait, Arctic grayling can spawn in streams that fall-spawning fish cannot because those streams may freeze solid in winter. Based on field observations, most small first-order streams in the Koyukuk drainage likely provide spawning, rearing, and/or summer feeding habitat for discrete populations of Arctic grayling (Wuttig et al. 2015). Elder Nasruk Cleveland of Shungank, Alaska suggests that grayling are the "eaters of roe." Whenever another fish lays eggs, the grayling eats the roe including the eggs of sheefish, whitefish, and salmon. They will especially follow and eat the sheefish eggs in the autumn (Cleveland and Foote 1980: 57).

Burbot spawn under the ice over clean gravels in late winter, in water as shallow as 1 foot deep (Mecklenburg et al. 2002; Morrow 1980). Burbot spawn in several major streams in the upper Koyukuk River drainage (Wuttig et al. 2015). The upper Wild River and the North Fork Koyukuk River downstream of Florence Creek are probable spawning areas (Wuttig et al. 2015). Northern pike are also an important target of subsistence harvests in this region (Anderson et al. 2004a; see Section 3.4.7, Subsistence Uses and Resources). Northern pike overwinter in relatively deep lakes and rivers, and after ice-out move into shallow, vegetated waters to spawn (Morrow 1980). The Alaska blackfish, found only in Alaska and Siberia, is unique in that it can breathe atmospheric oxygen, survive in poorly oxygenated waters unsuitable for other species, and tolerate extreme cold (Armstrong 1994; Sisinyak 2006). Lemke et al. (2013), ABR (2014), Wuttig et al. (2015), and Kane et al. (2015) provide additional detailed habitat and/or fish presence information for many streams and lakes in the study area.

ADF&G investigated waterbody crossings in the first 55 miles of the proposed route. Aerial survey efforts included visual observations for natural barriers to fish passage. On the ground efforts included minnow trapping and hook and line angling as well as backpack electrofishing at 23 crossings in

[25] Brown et al. (2012) describes whitefish biology based on several Yukon River basin studies.

tributaries to the Middle Fork Koyukuk, Wild, and John rivers. Sampling occurred over 4 days, and fish were observed at 16 of 23 sites sampled. Arctic grayling were the primary species sampled, but northern pike, burbot, and sculpin were also present (Bear 2022).

Salmon Declines

The Final EIS reported that Chinook and chum salmon returns to the Yukon and other rivers in northwest Alaska have declined since the late 1990s, resulting in seasonal restrictions and fishery closures (McKenna 2015). During the years since publication of the Final EIS (BLM 2020), Chinook, summer chum, and coho salmon populations have seen continued, marked declines in abundance (JTC 2022). These declines have led to restrictions on subsistence fishing and even the complete closure of commercial and recreational fishing activities for these species in the greater Yukon River watershed, including rivers in the study area (Jallen et al. 2022). Not only are these fish used for human consumption, but they also provide important sustenance for dogs used for both recreation and transport (Anderson 1992 in JTC 2022). The Yukon River Joint Technical Committee (JTC) includes the United States and Canada representation and meets twice annually to discuss escapement goals as well as pre-post season data trends, including cooperative research. The JTC reports that Canadian-origin Chinook salmon juvenile abundance in the Bering Sea has been below average since 2017 (JTC 2021, 2022). Furthermore, cumulative annual (since 1995) adult Chinook salmon passage at Pilot Station Sonar (the fish counting project nearest the mount of the Yukon River) was the lowest on record during 2022. These results were mirrored for Canadian-origin Chinook at Eagle Sonar in Canada (JTC 2022; USFWS 2022). These same patterns in escapement hold for summer chum and coho salmon observed in 2021 and 2022.

The Alaska Board of Fisheries has classified the Yukon River Chinook salmon as a stock of yield concern since 2000 and escapement goals have not been met between 2020 and 2022 (Jallen et al. 2022). As such, the board has taken management action to force in-season fishery closures for subsistence activities to protect fish swimming upriver (Jallen et al. 2022). Similarly, drastic declines in summer chum, fall chum, and coho salmon have been observed since 2020, leading to annual escapement goals not being met, resulting in complete closures of commercial fishing and closures or gear restrictions to subsistence and personal use fishing in 2023 (Jallen et al. 2022).

As salmon populations dwindle so has the average body size of all species of adult salmon in Alaska statewide since 2010 (Oke et al. 2020). The decline is most pronounced for Chinook salmon throughout the Yukon, Arctic, Norton Sound, Kotzebue, and Kuskokwim drainages. Mean freshwater age in years and mean saltwater age in years have also generally declined for all Pacific salmon except chum salmon. Several factors are thought to be at play, including increasing average global air and seawater temperatures (e.g., changes in population structure due to changes in ocean conditions or food availability) as well as interspecies interactions (e.g., competition for food resources). It is thought that this overall decline in salmon body size could have upstream impacts to ecosystem health through declines in available nutrients to various aquatic ecosystems and reduced egg production due to reduced fish size (Oke et al. 2020).

Chum salmon in Clear Creek (a tributary of the Hogatza River in the study area) is designated by the BLM as a Watchlist Animal, although there are currently no fish species whose range extends into the study area that are recognized as sensitive by the BLM[26] (BLM 2020; Esse and Kretsinger 2009;

[26] The 2019 BLM Sensitive Animals List for fish includes the Alaskan brook lamprey, Gulkana River steelhead, and Kigluaik Mountain Arctic char; Clear Creek chum salmon are on the BLM Watchlist Animals list (BLM 2019).

Kretsinger et al. 1994). However, the ADF&G considers Chinook salmon in the Yukon River system as a stock of yield concern.[27]

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act directs federal agencies to consult with the National Oceanic and Atmospheric Administration (NOAA) when any of their activities may have an adverse[28] effect on essential fish habitat (EFH). EFH refers to "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" for fish managed under a federal Fishery Management Plan, with Pacific salmon being the only managed fish in the study area (NPFMC 2012). The National Marine Fisheries Service defines freshwater EFH for Pacific salmon as "Freshwater areas used by egg, larvae, and returning adult salmon." The AWC identifies freshwater habitats important for Pacific salmon and NOAA considers such habitats EFH for managed species identified. Chinook, chum, coho, and sockeye salmon have EFH designated in numerous streams throughout the study area (see Volume 4, Map 3-17).

Aquatic Invertebrates

Aquatic invertebrates (small animals such as insects, crustaceans, mollusks, and worms that live in water) are critical components of freshwater ecosystems, serving as vital links in the food chain (Wipfli and Baxter 2010). They are a main food resource for most key fish species in the region. Juvenile Chinook, coho, and sockeye salmon, for example, feed on aquatic invertebrates in freshwater systems prior to outmigrating to the sea (Quinn 2005). Fish growth is often limited by food availability in streams (Quinn 2005). The availability of food resources in stream systems can also influence the timing, as well as the numbers, of successfully outmigrating smolts and ultimately play a role in the strength of the return (Quinn 2005; Clark et al. 2010). Aquatic invertebrates also perform important nutrient cycling functions by helping decompose materials in the water and are indicators of overall stream health (Milner and Roberts 1997). Although data specific to the study area are limited, Scannell (2015) assessed aquatic productivity in the Wild, John, Malamute Fork John, and Koyukuk rivers and examined stomach contents of captured fish. High water conditions during the spring sampling event may have influenced the overall low density and species diversity observed at the 4 sample sites. Scannell (2015) found chironomids (non-biting midges), mites, black flies, caddis flies, mayflies, stoneflies, copepods, and shrews in Arctic grayling stomachs; snails and beetles in humpback whitefish stomachs; and partially digested insect larvae in lake chub stomachs.

Amphibians

The wood frog is the only amphibian species in the project area and the only amphibian species north of the Arctic Circle. It is common throughout northern latitudes of North America and is uniquely capable of surviving extreme cold during winter dormancy (Kiss et al. 2011; Larson et al. 2014). Wood frogs occur in a wide variety of riparian habitats throughout Alaska and feed opportunistically on a variety of small invertebrates. Breeding pools are generally small and devoid of predatory fish. Wood frogs over-winter on land up to several hundred meters from breeding lakes (ANHP 2019). Surveys in GAAR identified individual wood frogs near Walker and Nutuvukti lakes, which are near Alternative A (Pyare and Gotthardt 2007). Studies have modeled suitable wood frog habitat throughout the state (ACCS 2019b; see Volume 4, Map 3-19).

[27] A stock of yield concern is defined as "a concern arising from a chronic inability, despite the use of specific management measures, to maintain specific yields, or harvestable surpluses, above a stock's escapement needs" (5 AAC 39.222(f)(42)).

[28] An adverse effect means "any impact which reduces quality and/or quantity of EFH."

Habitat reduction and fragmentation due to commercial and residential development have caused population decline throughout much of the wood frog's range (Reeves and Green 2006). Studies found a high incidence (as many as 19 percent of individuals sampled in some ponds) of abnormalities (e.g., missing, shrunken, or misshapen limbs) among wood frogs in Alaska (Reeves and Green 2006). Studies have linked the chytrid fungus (a fungal pathogen) to amphibian declines worldwide, and to rapid declines in boreal toads within Southeast Alaska (Nelson 2019; NPS 2015). ABR (2015) also notes it as a concern in Interior Alaska; however, Reeves (2008) notes occurrence and distribution of the fungus are not known.

Proximity to roads positively correlates with risk of skeletal abnormalities from multiple potential causes in Alaska wood frogs sampled at national wildlife refuges from the Arctic to the Yukon-Kuskokwim Delta, Interior, and Kenai Peninsula. Scientists said this could be due to chemical contamination of gravel and frog habitat, or by the roads facilitating introduction of predators, parasites, or pathogens (Reeves et al. 2008).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the road would not be built, and there would be no impacts to fish or fish habitat associated with AIDEA's proposal. However, under the No Action Alternative, current activities (e.g., mining exploration, recreational use) would continue throughout the study area, including access to the area via aircraft. Fish and aquatic resources would be affected by changing climate and permafrost conditions (see Sections 3.2.1, Geology and Soils, and 3.2.7, Air Quality and Climate) and other reasonably foreseeable future actions, as described below under Mining, Access, and Other Indirect and Cumulative Impacts.

Impacts Common to All Action Alternatives

In an effort to reduce the severity of impacts to fish and aquatic life, AIDEA has committed to using stream simulation design principles per USFS guidelines (2008) for all culverts placed in streams that support resident or anadromous fish. Stream simulation culverts are often wider than traditional fish passage culverts, allowing the simulated channel in the culvert to accommodate a range of flood flows and sediment transport scenarios without compromising fish and aquatic organism movement and without having detrimental effects to habitat upstream or downstream (USFS 2008). Channels within stream simulation culverts can effectively simulate many natural stream processes when properly designed (Barnard et al. 2013; USFS 2008). Additionally, the USACE special condition 5 on the project's Section 404 permit, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), requires AIDEA to install culverts 1.2 times the bankfull width of streams plus 2 feet. While floodplain function is not replicated and channel structure does not form on its own within the culvert,[29] large rocks or other stabilizing structures added during construction to mimic more natural conditions (USFS 2008; Barnard et al. 2013). AIDEA has committed to several other mitigation measures, as identified in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, that would minimize, but not eliminate, impacts to fish and aquatic species. Impacts to fish and aquatic species would occur during construction phases, O&M, and road closure and reclamation activities.

[29] Features that cannot be recreated within the culvert include flood-plain functions, channel structure, natural light, cohesive soils, channel bends, and habitat created from natural debris jams or channel-spanning wood (USFS 2008).

Properly designed, installed, and maintained conveyance structures would localize changes to physical habitat. This analysis assumes habitat within a distance of up to about 5 times the width of culverts and bridges may be most affected[30]. Habitat function within study areas may permanently change from existing conditions. For instance, the amount and/or quality of spawning and rearing habitat in study areas may be reduced due to scour and/or deposition. Fish assemblage and habitat characteristics at industrial road crossings sites in boreal forest often have result in issues like increased fine sediment deposition, dissimilarities between fish species composition and density downstream as compared to upstream, and elevated water temperatures due to culverts (Maitland et al. 2016; Sergeant et al. 2022). Whereas such differences are less pronounced for bridge crossings (Maitland et al. 2016). Because AIDEA has committed to installing fish passage culverts using stream simulation design in all fish-bearing streams crossed by the road (see also JROD, Appendix G, special condition number 5), potential impacts would be minimized. Appendix E, Table 16, provides multiple measures regarding stream, wetlands, floodplains, and proposed construction that help to define the likelihood and magnitude of impact. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. Section 3.2.5, Water Resources, discusses water quality and hydrology in more detail.

Specific road-related activities that would affect fish and other aquatic organisms include installing and maintaining bridges and culverts at stream crossings; mining gravel during construction and operations; withdrawing water from aquatic habitats to construct and maintain ice roads, compact gravel, suppress dust, and supply drinking water for construction and maintenance crews; discharging wastewater to surface water bodies; unintended use of the road by unauthorized users; and placing gravel fill to construct and maintain the roadway embankment and other infrastructure during all 3 project phases. The primary effects to fish and aquatic organisms would result from degrading habitat quality at and downstream of conveyance structures and gravel mine sources near rivers, potentially impeding seasonal habitat connectivity, modifying hydrologic conditions along the entire length of the road embankment, changes in water quality or quantity available in source lakes or rivers due to ice road development and maintenance; and introducing the potential for accidental spills of petroleum products, mineral concentrates, and other contaminants into aquatic habitats. Of particular concern is the potential for the road to accelerate the predicted rate of climate-driven permafrost degradation, which would further degrade downstream water quality, potentially inhibit fish movement, and may alter species distribution and abundance and influence fish populations (Evengard et al. 2011; Moquin and Wrona 2015; O'Donnell et al. 2017). While AIDEA commits to employing several design measures outlined in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, the implementation of such measures would reduce, but not eliminate, potential impacts to fish and aquatic organisms and their habitat. A summary of each project element and related effects, in consideration of the proposed design measures, is provided below.

The action alternatives propose to construct bridges across known Chinook and chum salmon spawning habitat[31] in the Yukon River basin and install culverts in more than 1,000 mapped streams[32], of which

[30] Observations suggest habitat within a distance of 5 times the width of the properly sized, installed, and maintained conveyance structures would be most affected; floodplain width assumed to be 3 times the diameter of a culvert width plus a roadway embankment at a 4:1 slope for Phase 3 width both upstream and downstream was used to estimate impacts to floodplains.

[31] Fish species habitat use data are not available for many streams crossed by the action alternatives; it is likely that salmon spawn in other streams crossed by action alternatives. Studies documented juvenile Chinook, coho, and, to a lesser extent, chum salmon in several study area streams (ABR 2015; ADF&G 2019a; Lemke et al. 2013; Scannell 2015) The BLM has evaluated the available fish and fish habitat information and has determined that the sufficient information exists for making a clear distinction among alternatives and a reasoned decision.

[32] Based on spatial review of alternatives' crossings of streams in the NHD, AWC and streams mapped by DOWL and assumed by AIDEA to provide fish habitat (DOWL 2019). Wetland and stream mapping produced by DOWL (2014a) was based on aerial photograph interpretation, site photographs, Light Detection and Ranging (Lidar) 2-foot contours, and 1:24,000 scale hydrologic stream data. DOWL (2014a) cautions that densely vegetated habitats precluded identification of small drainages (less than 12 feet wide) in some areas. Additional field data collection would be necessary to document all streams.

many are either known or assumed by AIDEA to provide habitat for anadromous and/or resident fish. Volume 4, Map 3-17, identifies known Chinook and chum salmon spawning areas and helps to define the extent of potential impact; however, because not all spawning areas are documented, spawning likely occurs in other suitable habitats as well (Larson et al. 2017). Bridges and culverts would potentially reduce the amount of anadromous and resident fish habitat and could alter habitat function. Properly sized and maintained bridges would have the least effect on fish habitat quality and function. Although culverts can be designed to ensure passage of various life stages of fish, they would still alter the characteristics of small stream segments by routing flow underneath the roadway embankment. Replacing natural habitat with culverts and confining flow through culverts and bridges would create localized adverse impacts to fish habitat, which could include reduced habitat complexity and increased sedimentation and scour potential. In some instances, culverts can impact the transport and storage of sediment and wood, which can adversely affect the instream habitat characteristics both upstream and downstream of the structures throughout the life of the road (Daigle 2010; Limpinsel et al. 2017; Maitland et al. 2016; Sergeant et al. 2022; Trombulak and Frissell 2000; NRC 2005; DOWL 2016a; Moore et al. 1999). Sedimentation, especially when increased over naturally occurring background levels,[33] affects habitat quality and function (DFO 2000; Jensen et al. 2009; Sergeant et al. 2022). Increased fine sediments could smother incubating eggs, decrease fry emergence, reduce the amount of suitable habitat for juvenile fish, and decrease benthic community production (Limpinsel et al. 2017). Elevated turbidity from suspended solids diminishes habitat quality, and may decrease primary production, the availability of food resources; elevate water temperatures, and affect feeding behavior; large plumes could damage gills and impair organ function (Limpinsel et al. 2017). In some cases, such conditions can be severe and if persistent, affect enough habitat and/or individuals to influence the size and/or strength of fish stocks or populations (Limpinsel et al. 2017; DFO 2000; Jensen et al. 2009). AIDEA's design features and the potential BLM mitigation measures would minimize impacts but not eliminate, impacts to fish and aquatic species.

AIDEA has committed to ensuring fish passage. Maintaining access to seasonal habitats during natural migration periods is critical to sustaining fish populations. Past studies have shown that inadequately designed, installed, or maintained culverts often lead to velocity barriers for upstream migrating fish and even properly designed culverts may lead to locally increased stream velocities at inlets and outlets (Burford Jr. 2005; Hotchkiss and Frei 2007; Limpinsel et al. 2017; NOAA n.d.). As a result of the road intercepting and rerouting the natural overland and stream flow paths of more than 1,000 mapped streams[34][35], velocity may increase in some streams and decrease in others. Such velocity changes in individual streams would be anticipated to be relatively minor and not be likely to alter fish species composition or distribution. AIDEA has committed to proper design and installation of stream simulation culverts to help maintain effective fish passage, habitat integrity, and drainage similar to natural conditions after construction that, along with regular maintenance, would be critical to maintaining fish populations (DOWL 2016a; see also Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Well-designed fish passage culverts, as AIDEA has committed to providing, would reduce but not eliminate maintenance issues. Throughout operations, routine inspection and maintenance of culverts and bridges would be necessary to ensure fish passage and minimize habitat degradation. Culverts would need to be cleared each year prior to spring breakup to avoid impeding fish movement, particularly for Arctic grayling and other species that migrate under the ice to reach spawning or other seasonal habitats. AIDEA has committed to developing an adaptive management plan for monitoring, maintaining, and repairing

[33] Sedimentation and deposition rates naturally fluctuate in rivers in response to flow and weather (e.g., precipitation, snowmelt).
[34] Based on spatial review of alternatives' crossings of streams in the NHD, AWC and streams mapped by DOWL and assumed by AIDEA to support fish (DOWL 2019b). Wetland and stream mapping produced by DOWL (2014a) was based on aerial photograph interpretation, site photographs, Lidar 2-foot contours, and 1:24,000 scale hydrologic stream data. Additional field data collection would be necessary to document all streams.
[35] DOWL (2014a) cautions that densely vegetated habitats precluded the identification of small drainages (less than 12 feet wide).

culverts over the life of the road, in consultation with ADF&G and the USACE. The Adaptive Management Plan would identify corrective measures and time frames to address inadequately performing culverts and the proposed subsistence advisory committee would help with plan oversight. Installation, regular inspections, and maintenance of properly installed crossing structures would reduce impacts to fish habitat.

AIDEA assumes that all perennial rivers and streams provide fish habitat and would therefore require fish passage (SF299). AIDEA also assumes that some well-defined ephemeral streams provide fish habitat (SF299). AIDEA has committed to providing fish passage at all crossings of perennial and well-established ephemeral channels that support fish using stream simulation design principles (see Appendix E, Table 16). ADF&G may require additional surveys be conducted at stream crossings, particularly where fish data are lacking, to inform culvert design during permitting.[36] AIDEA has committed to using culverts that would be designed and maintained to allow fish passage during natural migration periods (DOWL 2016a; see also Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Therefore, impacts from conveyance structures may be fairly localized within a given stream but widespread across the region since the road would traverse hundreds of small and large streams that may support fish.

Design features proposed by AIDEA (e.g., design fish passage culverts to comply with Washington stream simulation culvert width standards adapted for Alaska conditions) as described in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and other potential measures that the BLM could require (see Appendix N), such as regular culvert inspections and maintenance, would minimize potential effects to fish species abundance and distribution. Additionally, USACE Section 404 permit special condition number 12, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5),requires the project to develop an Adaptive Management Plan in consultation with ADF&G and the USACE that would include monitoring and corrective measures that would be taken to address any identified culvert performance concerns.

Activities in streams and along banks would temporarily impact habitat quality. Increased sedimentation and turbidity may be especially pronounced during and shortly after the combined Phase 1/Phase 2 and later Phase 3 construction periods and during road closure and reclamation activities. During Phase 1/Phase 2 construction, piles would be driven or drilled below ordinary high water of several anadromous streams in winter to support bridge piers and abutments.[37] Impact hammers generate underwater sound pressure levels that may displace, harm, or kill fish and/or incubating eggs exposed to harmful levels (Limpinsel et al. 2017; Stadler 2003; Hawkins 2005). Fish response is difficult to predict, and the extent of injury or harm to fish is difficult to quantify.[38] While some fish may die, impact hammer use would not affect enough individual fish to cause effects to fish populations. ADF&G promotes vibratory hammer use over impact hammers when feasible to minimize sound pressure impacts on fish. When pile driving requires impact hammers, ADF&G may require additional mitigation measures such as timing windows, slow ramp up to pile driving, acoustic barriers (i.e. bubble curtains), and/or acoustic monitoring with notification requirements should sound levels exceed acceptable thresholds. AIDEA's design measures (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) would minimize the potential for increased sedimentation and turbidity to affect fish habitat during construction and maintenance activities.

[36] The Fishway Act (AS 16.05.841) requires authorization from ADF&G for activities within or across a stream used by fish if such an activity may impede the efficient passage of resident or anadromous fish, which could include ephemeral streams.
[37] Abutments for small bridges, in addition to multi-span bridge piers, may be located below ordinary high water (DOWL 2016a).
[38] The effects of noise on individual fish depends on many factors, such as species and size; vertical location of fish and proximity to sound source; water current and depth; substrate composition and texture; peak noise level; noise frequency and rise time; and the presence or absence of predators since injured fish are more susceptible to predation (Limpinsel et al. 2017). Fish response ranges from avoidance to acute and sometimes fatal effects (damage to auditory receptors and rupture of the swim bladder to chronic effects; behavioral changes and long-term stress; Hastings and Popper 2005).

During permitting, ADF&G would establish in-water work timing windows to reduce construction-related impacts to fish for each construction phase and during road closure and reclamation activities.[39]

The placement of road embankments would change overland flow, change surface and groundwater flow patterns, and in some cases disconnect streams from low-lying, off-channel habitats (e.g., seasonally flooded wetlands, ponds) that would otherwise be seasonally accessible to aquatic species (Creamer 2019; Daigle 2010; Forman and Alexander 1998; Sergeant et al. 2022; Trombulak and Frissell 2000). Reducing habitat connectivity to seasonal habitats would reduce habitat availability for fish, including rearing Pacific salmon, and may increase pressure in available habitats. Such changes to the flow regime could reduce low flow stability in summer, fall, and winter, increase frequency and magnitude of peak flows in the season of thaw, and potentially alter stream thermal regimes (McDonough et al. 2014). While habitat that maintains a surface water connection to streams for longer duration may have a higher potential to support a broader composition of species, seasonal use of off-channel habitats and ephemeral streams is important for many species. While AIDEA would be required to maintain fish passage in streams crossed by the road, the road embankment would eliminate connectivity to some habitats as a result of altering hydrology across the project area and may increase competition in those still accessible to fish. Appendix E, Table 16, estimates acres of wetlands and waters[40] that would be eliminated[41] and helps to illustrate the magnitude of impact. Several of AIDEA's design features (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) would lessen, but not eliminate, impacts to fish and aquatic life.

During road closure and reclamation, AIDEA states in its application that it would remove culverts, bridges, and road embankments and recontour the road embankment to preconstruction grades (see Chapter 2, Section 2.4, Alternatives Retained for Detailed Analysis; Davis 2019a). AIDEA's proposed reclamation intends to maintain natural drainage patterns and preclude surface water from ponding along the reclaimed corridor (Davis 2019a). Removing culverts and bridges would disturb the streambed and may temporarily increase sedimentation, but would ultimately re-establish connectivity to aquatic habitats, including to off-channel habitats such as wetlands, where access may have been hampered by culverts. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, identifies design measures that would minimize potential impacts to fish and aquatic life. As noted above, there is uncertainty associated with reclamation and no plan has been submitted.

Roads alter the physical, chemical, and biological structure and integrity of aquatic habitat, could contribute persistent sediment loads, and increase rates of natural disturbances such as landslides (DFO 2000; Sergeant et al. 2022). The potential is especially important to consider given the proposed road's spatial location and extent. As permafrost continues to thaw, the potential for large thaw slumps and other physical manifestations of soil instability increases, which may cause sediment releases into spawning and other important fish habitats (Cho 2018; Murdoch et al. 2021; Vonk et al. 2015). Climate models have predicted that warming ground temperatures would continue to decrease the amount of permafrost throughout the region. Constructing and maintaining a road hundreds of miles long across a largely undeveloped area underlain by relatively warm permafrost has the potential to accelerate the predicted rate of permafrost thaw, especially given the shallow roadway design proposed for Phase 1 (Cheek 2008). Increased fine sediments have the potential to smother incubating eggs, decrease fish survival rates, and, over time, could reduce the strength of fish stocks or even populations (Limpinsel et al. 2017; Jensen et al. 2009). Even properly designed roads in permafrost-free areas could become major sources of increased sedimentation if not properly maintained (Limpinsel et al. 2017). Under a potential BLM mitigation measure, AIDEA would develop a long-term monitoring plan to ensure proper road maintenance,

[39] Installing conveyance structures would require temporary stream diversions.
[40] Data necessary to quantify acreage of impacts to fish habitat are not available; therefore, all waters are assumed to support fish.
[41] The impact to vegetation and wetlands near the roadway would also contribute to habitat degradation and increased erosion.

including culvert inspection, to reduce the likelihood of potential impacts to aquatic life (see Appendix N).

The road would introduce the potential for polycyclic aromatic hydrocarbons (PAHs), trace metals,[42] and other toxins to habitats that support sheefish, broad and humpback whitefish, salmon, and other fish harvested for subsistence use, by way of roadway runoff, accidental spills, and dust (Trombulak and Frissell 2000; Trumbull and Bae 2000; VTPI 2015; Nixon and Saphores 2007). Petroleum products are highly toxic to aquatic life, persist in sediments for many years, and are harmful to fish in very small concentrations in water or food (Brown et al. 2012; Incardona et al. 2004; Limpinsel et al. 2017 Reynaud and Deschaux 2006; Sergeant et al. 2022). Exposure to PAHs could result in injury and mortality for salmon and other species, and even dissolved PAHs are highly toxic to fish embryos at low concentrations[43] (Carls and Meador 2009; Incardona et al. 2015). Metals are highly soluble in water and fish are extremely vulnerable to metal toxicants in water since their gills are continuously exposed (Price 2014). High metal concentrations disrupt organ function and even low concentrations could lead to mortality[44] (Hughes et al. 2016; Mallat 1985; Wood 2001). Copper is a neurotoxin to fish and exposure to even very low levels impairs olfactory function and alters the behavior of salmon and other species (Limpinsel et al. 2017; Hughes et al. 2016). Increased metals could impact aquatic invertebrate health through uptake from sediments and riparian vegetation, then bioaccumulate up the food chain after consumption by fish and aquatic species (Fisher 1995; Limpinsel et al. 2017). Toxic metals that bioaccumulate in fish tissue can lead to fish mortality, increased susceptibility to disease, reduced growth rates, and pose health risks to human consumers (Hughes et al. 2016; Sergeant et al. 2022). Recent studies have shown that constituent components used to construct automobile tires can contaminate waterways when tire particles reach them, and they are toxic to coho salmon and potentially other fish species (French et al. 2022).

Dust from the road would increase fine sediment input and impact habitat quality (see Appendix E, Table 16), though USACE's special condition 22, which the BLM has adopted as a proposed mitigation measure (see Appendix N, Section 3.5),would require the project to perform dust abatement activities to prevent dust and gravel road spray from polluting aquatic resources. Calcium chloride, which may be used to control dust, easily leaches out of the soil during precipitation events and is toxic to fish (Barnes and Conner 2014) and wood frog larvae (Harless 2012). Calcium chloride inhibits growth of young salmonids; reduced growth rates at critical life stages have the potential to negatively affect recruitment and population dynamics (Hintz and Relyea 2017). The project proposes to employ mitigation measures to reduce the magnitude of potential impacts. The BLM could, for instance, not allow the use of calcium chloride and would consider the effectiveness of dust suppression relative to the impacts associated with the dust and the impacts of the calcium chloride use. Additionally, USACE special condition number 23, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5),, requires the project to not use dust suppressants with ingredients that may be potentially harmful to aquatic organisms within 328 feet (100 meters) of fish-bearing streams or higher value wetlands. However, even with the use of hydraulically sealed lids and truck rinsing procedures, ore concentrates are transported up to 2.5 miles (4 kilometers) from the Red Dog Mine haul road and low levels much farther (Hasselbach et al. 2005; Neitlich et al. 2017). Once in waterways, toxins may spread even farther. Surface runoff from the road could enter waterways and adversely affect water quality. Even low levels bioaccumulate in fish tissue and could impair fish behavior. Mines would also use the road to transport fuel and toxic processing chemicals[45] that, if spilled, would threaten aquatic life and be especially toxic when combined

[42] Refined petroleum (e.g., diesel, kerosene) have high levels of metals (i.e., lead, copper) (Akpoveta and Osakwe 2014).
[43] Embryo exposure to very low-level crude oil concentrations cause lasting cardiac defects in salmon (Incardona et al. 2015).
[44] Copper is a neurotoxin to fish; exposure to low levels impairs olfactory function and alters behavior (Hughes et al. 2016).
[45] Copper sulfate, hydrochloric acid, lime, methyl isobutyl carbinol, sodium cyanide, sodium diisobutyldithiophosphinate, sodium isopropyl xanthate, sulfuric acid, zinc sulfate, and adipic acid are commonly used in mines (DOWL 2016a).

(Price 2014). Design measures (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) would minimize, but not eliminate, potential impacts to fish and other aquatic life.

Spills have the potential to substantially degrade habitat quality and affect the long-term health of individual fish and fish populations. While the extent of potential impacts of a spill would depend on the material spilled, characteristics of the receiving habitat, and the speed and success of spill response, spills onto the roadway would occur. Habitat located near road crossing sites, which includes spawning, rearing, feeding, wintering, and migratory habitat, would be most susceptible to contamination from potential spills (see Volume 4, Maps 3-17 and 3-18, which help illustrate locations and extent of habitat and therefore likelihood of impact). In the event of a vehicle rollover, lid-locking mechanisms on closed container vehicles could be damaged and potentially toxic ore concentrate (and ore concentrates that may contain toxic dust) released into the atmosphere, onto land, and into waterways (see also Section 3.4.2, Transportation and Access). Such a spill, particularly if near a stream, could substantially alter water chemistry, cause fish mortality, substantially degrade habitat quality and function, and disrupt behavior (e.g., migration patterns). Even very small amounts of copper and other trace metals are known to adversely affect salmon and other fish species (Hughes et al. 2016). Spills of such materials into fish habitat has the potential to affect fish populations in the Kobuk River and Yukon River basins.

Streams and other aquatic habitats would be at risk of potential spills through final road closure and reclamation. Truck rollovers with spills, construction equipment and snowplow accidents, and other spill types happen every year on Alaska's roads in small but consistent numbers, according the ADEC spills database (ADEC 2019a). With nearly 50 years of industrial truck traffic planned on the Ambler Road and with transport of fuel, chemicals, and ore concentrate year-round and often in the dark, it appears likely spills would occur despite precautions. The risk of catastrophic spill (e.g., relatively large amounts of highly toxic material escaping directly into important fish waters before spill response could be initiated) is much less likely. Spills often contaminate soils, snow, and the road surface and require substantial clean-up. Less often, spills contaminate water and fish. The risk of a catastrophic spill is low but not impossible, and consequences could be high if such a spill occurred.

Changes to natural water chemistry parameters may reduce egg survival and affect fish populations (Limpinsel et al. 2017). Sheefish, for example, have very specific spawning habitat requirements, influenced in part by geologic features (Gerken 2009). Exposing materials with considerably different geologic composition may influence the water chemistry signature downstream. Even small changes in water quality could have substantial consequences to fish populations. Runoff from the road, even if not contaminated by spills, may alter downstream water chemistry (EPA 2019). NOA and acid-generating rocks occur throughout the study area. While a Yukon River study documented asbestos fibers in tissue of multiple fish species, it is unclear if and to what extent asbestos may be harmful to fish and aquatic life (West and Metsker 1983). There is also the potential that NOA released into rivers could lead to higher concentrations of some trace metals in fish tissues (Schreier et al. 1987), but analysis of effects to fish from asbestos are limited. The USACE Section 404 permit includes special conditions 29 and 30, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), that direct the project to avoid the use of materials containing NOA and to complete geotechnical investigations to identify areas to be avoided due to NOA or sulfide minerals that can cause acid drainage prior to beginning any permitted work. Embankment and fill material that may contain NOA would be exposed to the aquatic environment during road closure and reclamation, but it would be moved and disposed of in approved disposal sites in accordance with state and federal authorizations. Exposure and leaching of acid rock into waterways would substantially degrade habitat quality, alter water chemistry, and affect the health of fish and invertebrate populations. Pacific salmon and whitefish, including sheefish, may be most vulnerable to decreases in pH compared to existing levels. AIDEA indicates that cuts in acid rock areas would be avoided, but total avoidance may be difficult to achieve.

The elimination and fragmentation of wood frog habitat would likely not cause effects to frog populations due to the low density and wide distribution of the population. Frogs likely would be killed during road operations by vehicles, during vegetation removal, and by soil compaction. Unknown but possible are frog deaths from potential chemical contamination, through increased predation,[46] and by introduced parasites or pathogens.[47] The chytrid fungus has had a strong effect on amphibian populations in other locations, and an infected wood frog was found in Alaska (Reeves and Green 2006; NPS 2015; Nelson 2019), which indicates the fungus has made it to Alaska. While transfer of the fungus via roads apparently is not occurring across Alaska, it is possible the fungus could be transferred via roads to wood frog habitat in the project area. As a separate issue, proximity to roads is correlated with higher rates of wood frog physical malformations (Reeves et al. 2008), and increased chloride concentrations can reduce amphibian abundance and distribution (Sadowski 2002). The road may act as a vector for the introduction and movement of diseases that could infect wood frog populations beyond the ROW and invasive plant species that could degrade habitat quality (see Section 3.3.1, Vegetation and Wetlands).

Removing gravel from a stream channel changes the structure of its natural habitat for aquatic species, sediment transport dynamics and flow processes; degrades quality and habitat function upstream and downstream of mined areas; and alters fish and invertebrate communities (Brown et al. 1998; NMFS 2005). However, USACE special condition 10, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), would prohibit material mining from streambeds, riverbeds, active floodplains, lakeshores, and lake outlets and would not allow material sites to be located in active channels or floodplains. AIDEA has identified potential gravel mine sites on ridges, hillsides, and low-lying areas of floodplains and in some cases directly adjacent to active stream channels. Removing streambed gravel from relic channels in the active floodplain degrades habitat quality by reducing habitat complexity and altering hyporheic zone[48] dynamics,[49] which may affect survival rates of incubating eggs (Kondolf et al. 2002; NMFS 2005). Adverse impacts to fish may be relatively localized during the activity, although the full magnitude of effects is difficult to quantify given the lack of specific gravel extraction methods and plans.[50] AIDEA would be required to operate each gravel mine site under an approved SWPPP and incorporate measures to minimize potential impacts from erosion and sedimentation (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA).

Since stream channels naturally meander within their floodplains over time, it is plausible that the stream may eventually occupy the mined area, further perpetuating habitat degradation and reducing the availability of suitable spawning habitat.[51] Studies have shown that attempts to mitigate or restore streams impacted by gravel mining can be expensive and may be ineffective because impacts often extend kilometers upstream and downstream of mined sites (Brown et al. 1998; Kondolf et al. 2002). Existing management plans for the Indian River and Hogatza River Areas of Critical Environmental Concern (ACECs) indicate that material sites should not be located within the active floodplain of any stream within the existing ACECs (Kretsinger and Will 1995; Kretsinger et al. 1994). If the project were to commit to total avoidance of gravel mining in active floodplains regardless of land ownership and jurisdiction, impacts to fish habitat from gravel mining would be greatly reduced. Locating material sites outside of active floodplains could help to mitigate the project's cumulative impacts to fish and aquatic life. Gravel mining near sheefish and other whitefish spawning areas could have especially negative consequences to fish populations, since these fish have specific spawning requirements and large numbers

[46] The road may result in a localized increase in wood frog predation, as predators are attracted to human infrastructure and roads.
[47] Chemicals and pathogens in gravel or other material has contaminated habitat and cause limb malformations in Alaska.
[48] The hyporheic zone is where surface and groundwater interact beneath and adjacent to streams; it is critical for salmon spawning and egg incubation and regulates biological activity that affects stream health; see Hancock 2002 for more information.
[49] Dewatering mine pits adjacent to streams alters water quality, flow dynamics and may reduce downstream habitat availability.
[50] Increasing fine sediment input in spawning gravels decreases survival of salmonid eggs (Quinn 2005; Jensen et al. 2009).
[51] Small, unconfined streams may be more vulnerable to gravel mining than highly structured large rivers (Brown et al. 1998).

of fish spawn in relatively small, distinct areas. Blasting to support road construction and gravel mining throughout operations creates sound pressure levels that may harm exposed fish. Limits on the power of explosives would reduce impacts (Kolden and Aimone-Martin 2013; Timothy 2013).

AIDEA may close some material sites prior to reclaiming the road depending on whether the material site is needed for road maintenance or if all usable material was excavated to construct the road (Davis 2019a). AIDEA would stabilize material sites to prevent erosion and sedimentation into nearby water bodies or vegetation (Davis 2019a). Upon final road closure and reclamation, AIDEA intends to reclaim material sites by returning gravel from the road embankment to material sites (this may not be allowed on BLM-managed lands). This could transfer road-associated toxins into material sites and have unidentified impacts to local wetland and aquatic habitats. In any case, AIDEA would need to acquire authorizations to dispose of the material in approved locations and would need to comply with the state and federal stipulations regarding the disposal.

AIDEA would need to obtain authorizations from ADNR and ADF&G for each water source[52] prior to construction and is expected to follow typical stipulations to protect individual fish, such as providing a screen at the water intake.

Temporary ice roads and ice pads would be constructed during winter to support project construction during Phase 1 or during the combined Phases 1 and 2 option. Ice roads and ice pads would support gravel mining operations, project equipment and supply staging, and provide work platforms for bridge construction. Ice roads typically require 1 million gallons of water per mile of 25-foot-wide ice road and approximately 250,000 gallons per acre of ice pad (Cott et al. 2008).

Water needed to construct project ice roads and pads would be withdrawn from lakes or large rivers near the construction activity. Water withdrawals would be permitted by the State of Alaska through temporary water use authorizations issued by ADNR. Any work that requires water withdrawal is governed by AS Title 16, which ensures protection of fish habitat for anadromous fish and fish passage for any fish species and would necessitate issuance of fish habitat permits from ADF&G. Water withdrawal guidelines limit the total withdrawal volume based on individual water source characteristics, including the waterbody's overall volume, the waterbody's depth, the presence of resident fish, and the availability of liquid water during winter. If sensitive fish species are present in proposed water withdrawal lakes, water withdrawal would be limited to 15 percent of the estimated water volume below 7 feet. In lakes with only non-sensitive fish present, water withdrawal would be limited to 30 percent of the estimated water volume below 5 feet. In lakes without fish, water withdrawal would be limited to 35 percent of the total waterbody volume. Resistant fish include ninespine stickleback and Alaska blackfish, while all other species (e.g., Pacific salmon, whitefish, Arctic grayling) are sensitive. ADF&G's fish habitat permit includes requirements for water intakes to avoid fish injury (e.g., screened intakes, limited intake velocities).

During spring breakup, ice road segments and ice bridges can temporarily alter or block sheet flow and the natural distribution of surface waters (Arp et al. 2019). To minimize impacts from ice roads during breakup, ice bridges would be removed, slotted, or scored prior to spring breakup to avoid increased streambank erosion and impacts to aquatic habitat. Effects from ice infrastructure would be geographically limited to specific stream crossing locations and a stream-specific spawning fish population. While individual fish may be impacted, proper ice bridge removal would prevent population-level impacts.

[52] While the water access points have been proposed within GAAR, they have not all been identified outside of GAAR.

Ice road water withdrawal and meltwater runoff would alter water quality and water flows in study area streams, rivers, and lakes along the corridor compared to their current, mostly natural conditions (Cott et al. 2008; Gädekee et al. 2022). Ice road and ice pad meltwater could have temporary localized effects on water quality (e.g., specific conductance, pH). Water withdrawal for ice infrastructure can alter fish habitat by reducing the quantity of water available for fish and affecting water quality (e.g., dissolved oxygen, pH, conductivity) (Arp et al. 2019; Cott et al. 2008). Aquatic habitat impacts from water withdrawal would be temporary and short term, lasting until spring breakup which would recharge the lake. Water withdrawal at individual permitted lakes is not anticipated to affect resident and anadromous fish populations, though the withdrawals would cause minor fluctuations in water levels during winter which could impact fish habitat (e.g., dissolved oxygen).

Regardless of the intended use for water withdrawals, permit stipulations set forth by ADNR and ADF&G also limits the quantity of water that can be removed from each source to minimize impacts to aquatic life and ensure suitable habitat is maintained throughout the year. Nonetheless, water withdrawals may kill or injure some small individual fish and invertebrates, but water withdrawal would not be anticipated to affect fish populations if typical permit stipulations were followed and enforced.[53] While water needs would vary for each phase, the types of impacts to fish would be similar though potentially more widespread during times when more water is required. While it is challenging to predict the level to which the road may affect fish and aquatic invertebrate species, it is likely that water withdrawals, warmer water temperatures, increased sedimentation, and changes in flow could contribute to changes in aquatic invertebrate abundance and distribution. Declines in food resources that are available for salmon and other fish species, which are already food-limited in Arctic ecosystems, may limit growth rates and reduce fish survival (Reist et al. 2006). Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, identifies AIDEA's design features that would reduce, but not eliminate, potential impacts. Appendix N identifies additional measures that the BLM could require of AIDEA on BLM-managed lands to minimize impacts to fish and aquatic life.

During the creation of alternatives for the project and later during the Final EIS public scoping process, significant discussion has been given to concerns over unauthorized use of the road by unauthorized users. Much of the debate relates to potential impacts to area resources through potential increased traffic, damage to the road and other Project resources, trespassing on Native allotments, and exploitation of otherwise inaccessible wildlife resources, including fish. The project as proposed by AIDEA would include a staffed gate near the project's Dalton Highway terminus, which would limit access to authorized drivers and prevent public access to the road. A similar gate would be constructed at the project's west end, near the District's boundary. See Section 2.4.4, Design Features Proposed by AIDEA, for additional details on who would be granted access to the project road. Appendix H, Section 2.2, Road Access Scenarios, provides a summary of the restrictions AIDEA proposes to control access to the road. Federal statute and regulations provide that BLM and NPS determine the scope of allowable access through the terms and conditions of any ROW authorizations they may issue; AIDEA would have no independent discretion or permit authority if issued a ROW.

Alternative A Impacts

The road route proposed under Alternative A would cross the Kobuk River and more than 20 of its tributary streams that flow directly into the Kobuk River sheefish spawning grounds. Distances from the crossings to the known spawning grounds vary but are in the 12-to-15-mile range. The Kobuk supports "the largest population of spawning sheefish in northwestern Alaska" (Scanlon 2009:7; Taube and Wuttig

[53] Fish can become entrained (pulled into intake pipe) or impinged (suctioned against screen) during water withdrawals. Permit stipulations are designed to prevent fish from becoming impinged or entrained by water withdrawal pumps or intake infrastructure (McLean 1998).

1998). The road could introduce contaminants, including but not limited to PAHs, chemicals associated with mining, and toxic ore, and sediment into waters known to support sheefish, broad and humpback whitefish, Chinook, chum, and coho salmon, and several other species that are extremely important for subsistence harvest throughout the region. While Volume 4, Map 3-17, identifies known Chinook and chum salmon spawning areas, spawning likely occurs in other suitable habitats. Volume 4, Map 3-18, shows documented sheefish and other whitefish spawning locations. A spill into these waterways has the potential to affect sheefish as well as multiple salmon populations. The maps help to illustrate the extent and likelihood of potential impacts. Alternative A would also cross several fish streams that ultimately contribute flow to the Alatna River upstream of documented sheefish and whitefish spawning grounds and in the vicinity of known salmon spawning areas.

Appendix E, Table 16, which identifies several metrics considered in assessing impacts to fish, can be used to make general comparisons of potential impacts between the action alternatives regarding the likelihood and magnitude of potential impacts. The Alternative A road route would cross the fewest number of streams and would be considerably shorter in length than Alternative C. Alternative A would cross streams much farther upstream in the drainage basins than Alternative C and would not cross streams directly within existing ACECs. Because of its location near and upstream of sheefish habitat, Alternative A has a greater potential to directly affect Kobuk River and Alatna River sheefish spawning habitat than Alternative C. Alternative B would include a similar number of crossings as Alternative A but would cross the Reed River within approximately 7 miles of Kobuk River sheefish spawning habitat, closer than the other action alternatives. Alternative C would cross the Kobuk River downstream of sheefish spawning habitat. Because stream and fish data are not available for all action alternatives at the same resolution, exact comparisons of fish stream crossings among alternatives are not possible. However, the BLM reviewed the information that is available and determined that the difference in resolution among alternatives is not essential to making a reasoned choice among the alternatives, because enough is known to determine comparative impacts. The overall costs and time of obtaining the same level of fish data for all alternatives would be exorbitant. To disclose impacts, the BLM relied on published data and input from subject matter experts and cooperating agencies in interpreting available data.

Ice road development would be required during Phase 1 development of each alternative. Ice roads can have many of the same impacts on aquatic resources, as described above for other road types. However, ice road construction and maintenance use more water than all other road development activities (e.g., dust suppression, camp potable water) combined. As noted in Impacts Common to all Action Alternatives, ice roads can impact fish and aquatic organisms during withdrawal of water by decreasing available water volume (overwintering habitat) and reducing oxygen and nutrient levels. During the melt season, ice roads can impact stream and lake hydrologic function and introduce sediments and contaminants into waterbodies which might impact fish and aquatic life. Alternative A would have a similar level of impact to fish and aquatic species as Alternative B due to the length of the roads being similar, although fewer of Alternative A crossings would be located closer to important known sheefish spawning habitat as in Alternative B. Alternative A impacts would be less than for Alternative C, which has a longer route and would require greater acreage of ice pad staging areas. Overall impacts from ice road development under Alternative A would potentially impact all waterbodies along the road corridor, but for short duration during spring melt. These impacts should be limited due to ADF&G and ADNR permit stipulations which would determine the quantity and timing of water withdrawal by source. Suggested mitigation to reduce impacts from water withdrawal for ice roads would include 1) prohibiting compaction of snow cover or the removal of snow from fish-bearing streams except at ice road crossings, water pump stations on lakes or for ground ice, and 2) removing ice infrastructure over defined stream channels, by breaching or slotting prior to spring breakup to allow flow connectivity and to minimize blockages and damage to stream banks or stream beds.

Alternative A proposes gravel mine sites in floodplains at several locations, including directly adjacent to known salmon and whitefish streams. Nearly half of the material sites proposed under Alternative A would be located in a floodplain and/or within 500 feet (152 meters) of fish streams (see Appendix E, Table 16, helps illustrate the likelihood of impacts to fish habitat related to floodplains). Material sites in the floodplains could degrade anadromous habitat quality in the John, Malamute Fork Alatna, Alatna, Kobuk, Reed, Mauneluk, Kogoluktuk, and Ambler rivers and Beaver Creek, in addition to several smaller streams that may support fish (see Volume 4, Maps 2-3, 3-5, 3-6, 3-17, and 3-18 for extent of potential impacts). Gravel mine operations would be subject to SWPPPs and other measures which would reduce, but not completely eliminate, potential impacts to streams and aquatic life from erosion and sedimentation.

Unauthorized use of the road by the public is a possibility for all action alternatives. However, most actions by unauthorized users would have only localized and temporary impacts to fish and aquatic resources (e.g., fishing, or all-terrain vehicle [ATV] use in streams). These impacts are likely to be of the same magnitude for each alternative with most impacts occurring closest to the entry gate near the Dalton Highway. However, it is possible that Alternative C would have a higher potential for impacts from unauthorized use due to placement of the route in closer proximity to a metropolitan area (Fairbanks). However, mitigation procedures (see Section 2.4.4, Design Features Proposed by AIDEA), including a full-time staffed gate and security personnel along the route, would reduce the potential of impacts from unauthorized use.

Alternative A would have the smallest footprint, eliminate the fewest acres of waters and wetlands (see Appendix E, Table 11), and require the fewest stream crossings (see Appendix E, Table 16) compared to the other action alternatives. Conveyance structures proposed by Alternative A are estimated to affect a similar amount of fish habitat as Alternative B but much less than Alternative C (see Appendix E, Table 16). Based on these estimates, impacts to wood frogs, aquatic invertebrates, and fish would likely be less for Alternative A than for the other action alternatives.

Alternative B Impacts

Similar to Alternative A, Alternative B would cross several fish streams that flow directly into the Kobuk River and Alatna River sheefish spawning grounds, which are shown in Volume 4, Map 3-18, and in the vicinity of known salmon spawning areas (see Volume 4, Map 3-17). While Alternative B would include a similar number of crossings as Alternative A, several would be located closer to important sheefish and known whitefish spawning areas. Alternative B would cross the Reed River within about 7 miles of Kobuk River sheefish spawning habitat. Alternative B would also cross several tributary streams of Jack Beaver Creek, which is located just upstream of important whitefish and sheefish spawning habitat in the Alatna River.

Alternative B water withdrawals for ice road development would be similar to Alternative A but could have slightly greater impacts to fish and aquatic resources due to the need for source water to build ice roads in areas that are in closer proximity to sheefish spawning habitat. Alternative B is likely to have fewer impacts from ice road development than for Alternative C, which is a longer route.

The location of crossings relative to sheefish spawning could put this limited spawning habitat at risk of degradation and contamination from potential spills. Like Alternative A, Alternative B would not cross streams within existing ACECs. Alternative B proposes a similar number of gravel mine sites in floodplains and/or low-lying areas within 500 feet (152 meters) of fish streams as Alternative A, including directly adjacent to known salmon and whitefish streams, as shown in Appendix E, Table 16. Material sites in these areas would impact fish habitat quality in the John, Malamute Fork Alatna, Alatna,

Kobuk, Hogatza, Mauneluk, Kogoluktuk, and Ambler rivers and Beaver Creek, in addition to several streams that support fish. While effects to fish, aquatic invertebrate, and wood frogs would be similar, slightly more habitat would be impacted under Alternative B than Alternative A (see Appendix E, Table 12).

Impacts from unauthorized use would be similar to Alternative A due to the similar length of the road route but slightly less than Alternative C, which begins closer to a metropolitan area.

Alternative C Impacts

The Alternative C route would be much longer than the other action alternatives. Alternative C would cross several more fish streams than Alternative A or B and, due to challenging topography, would be routed along floodplains more often and for longer distances than the other action alternatives. Alternative C would route over 80 miles of industrial road within 1,000 feet of major floodplains and/or streams (identified by the National Hydrology Dataset [NHD]), which may put these waters at a higher risk from potential spills and increased sedimentation. For comparison, about 16 miles and 20 miles of the Alternative A and Alternative B industrial road alignments, respectively, would be routed within 1,000 feet of major floodplains and/or NHD streams. Alternative C would have the most miles of ice roads constructed, potentially impacting fish and aquatic resources to a greater degree than both Alternatives A and B.

Alternative C would cross the Kobuk River downstream of known sheefish spawning habitat. While the road would still introduce the potential for spills into sheefish, whitefish, and salmon habitat, it would be less likely to directly affect sheefish spawning habitat in the Kobuk River. Alternative C is routed through habitat on the Koyukuk River that was previously identified as a sheefish spawning area; however, previous surveys suggest this habitat may not be used by sheefish for spawning (Brown and Burr 2012).

Alternative C is the only alternative that would cross streams within existing ACECs. The BLM has developed Habitat Management Plans for the ACEC's in the Indian, Tozitna, and Hogatza drainages. These plans have management guidelines that provide specific identification and protection of the fisheries habitat within the ACEC. Alternative C would cross and run parallel to the Tozitna and Indian rivers within existing ACECs and along the Hogatza River upstream from the existing ACEC. Alternative C would construct more bridges than the other action alternatives, which would damage fish habitat less than culvert crossings. However, the Alternative C route would require installing over 4,000 minor culverts and many more moderate and major culverts, substantially more than the number of culverts proposed by the other alternatives. Since the resolution of available stream and fish data varies across alternatives and crossing locations have not been fully identified for Alternative C, more detailed comparisons among alternatives are not possible. The BLM has evaluated the available fish and fish habitat information and has determined that sufficient information exists for making a clear distinction among alternatives and a reasoned decision.

Alternative C also proposes gravel mine sites directly adjacent to known salmon and whitefish streams. Fewer material sites would be located in floodplains and/or within 500 feet (152 meters) of fish streams for Alternative C compared to the other action alternatives (see Appendix E, Table 16). Material sites in the floodplains would degrade the quality of anadromous fish habitat in the Ray, Tozitna, Indian, Kobuk, Hogatza, and Ambler rivers, as well as several streams that support fish. Because Alternative C would result in the largest footprint and affect the most acres of waterbodies and wetlands, impacts to fish, aquatic invertebrates, and wood frogs from impacts to habitat would be greater than under the other action alternatives (see Appendix E, Tables 13 and 16, help to illustrate the likelihood and magnitude of impacts).

Impacts from unauthorized use of the road to access fish and aquatic resources may be slightly greater under Alternative C than for Alternatives A and B due to the proximity of the route to Fairbanks.

Combined Phasing Option

Under the combined phasing option, the road (under any of the three alternatives) would be built to Phase 2 specifications, eliminating Phase 1 activities. Potential impacts to fish and aquatic resources from combined phasing would stem from initial construction of a wider road requiring longer culverts during the combined Phase 1 and Phase 2 effort. The road would therefore require more water withdrawals for ice road/pad development, more fill material and initial construction traffic, all of which could impact fish and aquatic resources through impacts to water quantity and quality in the short term. However, this phasing option was specifically developed "to address impacts on permafrost, water quality, and fish and to otherwise reduce noise and disturbance impacts from staging and operating construction equipment for 2 separate phases." As such, most project impacts would be greater in the short term, regardless of alternative, due to the increased construction time required under the phasing option compared to beginning a route with Phase 1 only. However, the long-term impacts to fish and aquatic resources would be reduced overall through the phasing process in which Phases 1 and 2 are combined followed by an unknown time interval prior to commencement of the Phase 3 option, if Phase 3 is developed.

Essential Fish Habitat Impacts

All action alternatives would reduce the amount and impact the quality of EFH. All action alternatives would construct bridges across documented EFH streams. Several known EFH streams could be adversely affected as a result of gravel mining, depending upon the proximity of the mining activity to the stream and floodplain. Effects to salmon and EFH from installing, operating, and maintaining bridges and culverts and the road, removing gravel from the floodplain of EFH streams, spills, and withdrawing water throughout the life of the project would be similar to those described for all action alternatives. Proposed activities may influence surface and groundwater flow (hyporheic zone) dynamics, which could ultimately influence salmon production rates. Construction and operation of any action alternative would affect EFH and could impact individual Pacific salmon in localized areas, as described above. Further discussion of these impacts is included under Indirect and Cumulative Impacts, below.

Appendix E, Table 16, estimates the number of EFH streams crossed by each alternative and the amount (magnitude) of habitat that may be most affected and providing context for the likelihood of impact. It is likely that more streams and wetlands support Pacific salmon than have been identified to date, and would therefore be considered EFH. AIDEA would be required to conduct additional surveys during permitting to supplement existing data.

Alternative C would cross more documented EFH streams and impact more documented EFH than the other action alternatives. Alternative A would have 1 less EFH stream crossing than Alternative B. Note, however, that fish sampling has not been conducted for most streams in the project area. While comparing the number of EFH stream crossings is useful, a detailed and quantitative comparison of potential impacts to salmon and EFH between alternatives would require additional data collection.

USACE special conditions 5 through 12, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), include measures to protect anadromous fish and aquatic habitat.

Mining, Access, and Other Indirect and Cumulative Impacts

RFAs associated with AIDEA's proposed action that would impact fish and aquatic species include climate change, the advanced mining development scenario, indirect road access scenario, and other actions located throughout the vicinity of the project area (see Appendix H). Several coal and other hard

rock mining claims occur in the project area. Construction of an industrial road to the District could yield future hard rock and coal mine proposals. Because development of these additional areas is speculative, a detailed development scenario is not included in this Supplemental EIS and cumulative impacts from such development are assessed only in broad terms.

Previous mining development, primarily activities related to placer gold mining, has affected aquatic habitat in portions of the project area. Brown et al. (2012) identified potential threats and concerns from development in the Koyukuk River drainage. The following text is an excerpt from Brown et al. (2012):

> Development impacts to whitefish resources in the Koyukuk River drainage could come in several different forms including mineral extraction, riverbed gravel mining, and roads. Placer gold mining in the drainage began in the late 1800s, primarily in the upper drainage tributaries of the Alatna, John, Wild, North Fork Koyukuk, Middle Fork Koyukuk, and South Fork Koyukuk rivers (Brown 2007b). Miners initially accessed the region by paddlewheel steamboats and other smaller boats during the summer months and overland from the Yukon or Chandalar River drainages using dog teams or on foot in the winter months (Buzzell 2007). Additional large-scale placer mining operations began in the Indian and Hogatza River drainage in the 1930s and 1940s (Smith 1939; Boswell 1979). The Hogatza River placer mine is located in a western tributary named Bear Creek, where a large floating dredge was employed to efficiently mine the entire valley (Figure 14). As recently as the early 1980s, this dredging operation was discharging highly turbid water and impacting the streambed with fine sediments as far as 40 km [25 miles] downstream from the mine, as documented by Webb (1983b). Presumably the mine has improved its settling pond system to bring its water discharges more in line with State water quality standards, as detailed by Lloyd (1987). Numerous placer gold mining operations continue within the Koyukuk River drainage, primarily in the upper reaches of the Middle Fork Koyukuk River drainage and in the Bear Creek region of the Hogatza River drainage (Szumigala et al. 2001, 2008). Despite the unavoidable disruption of stream substrate that occurs with placer mining operations, none are directly threatening known whitefish spawning habitats at this time.
>
> During construction of the Dalton Highway and the Trans-Alaska Oil Pipeline in the 1970s, a large amount of riverbed gravel was removed from upper drainage tributaries of the Koyukuk River including Prospect Creek, Jim River, Middle Fork Koyukuk River, and Dietrich River (Woodward-Clyde Consultants 1980). More recent (1990 to present) riverbed gravel mining operations have taken place in the main-stem Koyukuk River drainage at Allakaket (ADL 415878), Hughes (ADL 414384), and Huslia (ADL 400510). During an aerial survey in late September, which is spawning season for inconnu, Alt (1970) reported seeing spawning aggregations of inconnu in the vicinity of Hughes and Allakaket, as well as up the Alatna River near Siruk Creek. Presumably these inconnu were spawning in these areas. *It is possible that streambed gravel removal activities at Allakaket and Hughes have already reduced inconnu spawning habitat in the region.* If inconnu spawning activity in the Koyukuk River drainage is as widely distributed as Alt's (1970) aerial survey data suggest, the riverbed gravel removal activities identified above may not have had a serious impact on the population. Riverbed gravel removal from spawning habitats, however, is a potential threat to whitefish populations, particularly if their spawning habitats are more limited in geographic size. We know of no plans to extract gravel from any of the known whitefish spawning habitats, but these habitats should be considered when planning riverbed gravel extraction projects in the future.

Aside from the few gravel roads near communities and those used to support past and current mine exploration, the project area is largely devoid of roads. Existing infrastructure is limited and seasonal fish movement is generally not impeded within the project area. Construction of TAPS, the Dalton Highway,

and more recently, the fiber-optic lines adjacent to the highway, has impacted habitat quality and limited fish passage in several large rivers and smaller tributary streams at the eastern edge of the project area. This existing infrastructure has affected habitat in numerous rivers that flow into drainages within the project area but at locations farther upstream in the drainage. For example, the Dalton Highway crosses the Yukon River and runs adjacent to the Ray River just east of Alternative C and crosses several of its tributaries. The highway has affected habitat where it crosses and runs adjacent to Fish Creek, Bonanza Creek, Prospect Creek, and the Jim River, all of which are tributaries to the South Fork Koyukuk River, and the highway crosses the South Fork Koyukuk River near the eastern extent of the project area, just south of where Alternatives A and B would connect to the Dalton Highway. The highway runs adjacent to the Middle Fork Koyukuk River at a point about 5 miles farther north. In its Fish Passage Inventory Database,[54] ADF&G identifies several culverts that limit or preclude fish passage along the Dalton Highway (ADF&G 2020).

The indirect and cumulative impacts from development of mines and secondary access roads within the District, other development or activities, and climate change, would be additive to the impacts to fish and other aquatic organisms described above. Construction of the road is anticipated to lead to the development of large-scale hard rock mines near habitat that is essential for Chinook, chum, and coho salmon; sheefish; broad and humpback whitefish; Arctic grayling; and several other species that are integral to the subsistence practices throughout this region. Mining and its associated activities have the potential, if not properly managed, to substantially impact habitat structure, quality, and function and affect fish species at the population level. Hard rock mining could disrupt natural surface and groundwater interactions and processes, reduce the amount of EFH for already declining stocks of Pacific salmon, likely impact water quantity and quality, affect biodiversity and fish production, and may require treatment of toxic mine water in perpetuity (Hughes et al. 2016; Limpinsel et al. 2017; Woody et al. 2010). Mine dewatering has the potential to substantially reduce groundwater flows into important spawning, egg incubating, and wintering habitats relied upon by salmon, sheefish, whitefish, and other species. Mine-induced alterations to the surface and groundwater exchange patterns can create additional pathways for the dispersal of contaminants. Adverse impacts to water quality were found to be common at mine sites and most often caused by failed mitigation (Kuipers et al. 2006; Maest et al. 2005; Sergeant et al. 2022; Woody et al. 2010).

There are 4 potential large-scale mining projects in the project area identified for analysis of potential impacts to aquatic resources. Ambler Metals (formerly Trilogy) has funded multi-year aquatic biomonitoring studies in streams located near the Arctic and Bornite prospects (Bradley 2017, 2018; Clawson 2022 and 2023; Trilogy 2018a). The Arctic and Bornite prospects are located within the Shungnak River drainage, upstream from its mapped extent of anadromous fish habitat (Clawson 2022 and 2023; Johnson and Blossom 2019a). While there is a series of rapids in a canyon just upstream from this point, ADF&G has indicated that the rapids are not necessarily a barrier, and chum salmon may occur farther upstream (Giefer 2018). Upstream from the canyon, the Shungnak River supports self-sustaining populations of Arctic grayling, Dolly Varden, round whitefish, slimy sculpin, longnose sucker, and Alaska blackfish (Clawson 2022 and 2023). If developed, the Arctic Project's tailings management would be constructed within the valley of Subarctic Creek near its headwaters (Trilogy 2018a). Subarctic Creek is a Shungnak River tributary that supports multiple age classes and life stages of Dolly Varden, Arctic grayling, and sculpin (Bradley 2018; Clawson 2019). Dolly Varden spawning has been confirmed in the upper reaches of Subarctic Creek (Clawson 2019). The Bornite Mine would be located primarily within the Ruby Creek drainage and potentially extend into the Jay Creek drainage (see Appendix H, Map 10).

[54] The Fish Passage Inventory Database contains data on more than 2,500 stream crossings assessed for fish passage by ADF&G since 2001. The information is available online to the public via the Fish Resource Monitor interactive mapping application.

Ruby Creek supports Dolly Varden, Arctic grayling, round whitefish, longnose sucker, and slimy sculpin, and Jay Creek supports Dolly Varden (Bradley 2018; Clawson 2019).

Additional infrastructure to support the Arctic Mine would likely be necessary along the Shungnak River and within the Ambler lowlands, which is the divide between the Shungnak and Kogoluktuk rivers (Trilogy 2018a). Riley Creek, a tributary to the Kogoluktuk River, was identified as a possible location for a tailings facility (Clawson 2019). Riley Creek supports sculpin and potentially both anadromous and resident Dolly Varden populations (Clawson 2019). The Kogoluktuk River supports Pacific salmon and several other subsistence species and flows into the Kobuk River just downstream of habitat that supports large concentrations of spawning sheefish (Scanlon 2009:7; Taube and Wuttig 1998) (see Volume 4, Maps 3-17 and 3-18).

The Sun Project would be in the Beaver Creek drainage. Beaver Creek supports Pacific salmon and several other subsistence species (Johnson and Blossom 2019a). Beaver Creek flows directly into the productive Kobuk River sheefish spawning grounds. The Smucker Project would be located farther to the west, within the Ambler River drainage. The Smucker prospect is situated within the Kalurivik Creek drainage just east of Cross Creek (see Appendix H, Map 10). Fish sampling records were not found for Kalurivik Creek, but based on review of topography and fish presence data available for similar areas, this drainage likely supports both anadromous and resident fish.

Mining and its associated activities have the potential, if not properly managed, to substantially impact habitat structure and function and could also affect fish species at the population level, as described below. Proper management would minimize, but not eliminate, the potential for impacts to individual fish as well as population-level effects on fish. Often the most severe mining-related impacts to habitat occur in remote areas located near extremely productive fish habitat (Sengupta 1993, as cited in Limpinsel et al. 2017). Hard rock mining often involves moving massive amounts of soil and rock, which disrupts the natural surface and groundwater interaction and associated hyporheic[55] processes, reduces extensive amounts of aquatic habitat, can seriously impact water quality, decrease water quantity, reduce biodiversity and carrying capacity, and require treatment of toxic mine water (Hughes et al. 2016; Limpinsel et al. 2017; Woody et al. 2010).

The 4 most advanced, large-scale mining projects would target copper, lead, zinc, silver, and gold and perhaps, to a lesser degree, cobalt and molybdenum. Hundreds of smaller claims exist throughout the study area, and if the project road were built, further development would be more likely to occur. Direct and indirect chemical stressors such as mining-related pollution, acid mine drainage, and the release of toxic materials have the potential to impact the health and the survival of fish populations and other aquatic species (Limpinsel et al. 2017). Toxic metals that bioaccumulate in fish tissue can lead to fish mortality, increased susceptibility to disease, and reduced growth rates and can pose health risks to human consumers (Hughes et al. 2016; Peplow and Edmonds 2005). Agencies with jurisdiction would propose mitigation measures to avoid and minimize water quality impacts; however, that does not ensure the measures would be fully effective. Sheefish, in part because they mature at an older age and prey on other fish (Brown et al. 2012), could be particularly vulnerable to toxic bioaccumulation from pollutants that enter rivers via road runoff, including mercury and various PAHs (Matz et al. 2017). Mine-related disruptions to soil and water can substantially impact water quality and alter stream flows (Woody et al. 2010). As a mine is excavated, pumps are used to remove mine water and allow access to the ore. Removal of natural groundwater (which typically is held and treated as non-contact or contact water as indicated in Appendix H, Section 2.1.4, Reasonably Foreseeable Mine Development Scenario, and may be discharged far from the source) creates a cone of depression in the groundwater table, which can lower

[55] The hyporheic zone is the region of sediment and porous space beneath and alongside a stream bed that provides the linkage between surface and groundwater systems and riparian and floodplain habitat.

the water table well below natural stream or lake levels and considerably reduce flow into streams, the hyporheic zone, and wetlands (Hughes et al. 2016; Woody and Higman 2011). The hyporheic zone is the region of sediment and porous space beneath and alongside a stream bed that provides the linkage between surface water and groundwater systems and riparian and floodplain habitat. The importance of the hyporheic zone to the health and survival of fish cannot be overstated. It is used for spawning and egg incubation for many fish species in the study area that are major targets of subsistence harvest. After eggs hatch, larvae may move both down and laterally into the hyporheic zone to absorb yolk sacs (Woody and Higman 2011). The porous sediments of the hyporheic zone along stream banks also help to regulate changes in water levels and even prevent flooding (Hancock 2002[56]). Hyporheic zones are important in stream nutrient cycling and the regulation of temperature and water quality and provide unique habitats for fish and aquatic invertebrates.[57] Depending on the location and scale of operation, dewatering has the potential to substantially reduce groundwater flows into important spawning, egg incubating, and wintering habitats relied upon by salmon, sheefish, whitefish, and other important subsistence species. Mine-induced alterations to the exchange patterns of surface and groundwater has the potential to create additional pathways for dispersal of potential contaminants. Eliminating wetlands and altering the natural water regime can lead to reduced low-flow stability in summer, fall, and winter; increased frequency and magnitude of peak flows during spring breakup; and potential alteration of stream thermal regimes (McDonough et al. 2014).

It is difficult to quantify the impact that future mines may have on fish and aquatic habitat, given that specific mine proposals and associated mitigation measures are not available. Further, baseline water quality and fish distribution data are not available for many areas where development may occur. In an effort to examine impact predictions, researchers reviewed several EISs for hard rock mines in the United States and compared predicted water quality conditions to actual water quality conditions during and after mine operation (Kuipers et al. 2006). The study found that impacts to water quality were common at mine sites and most often caused by failed mitigation (Kuipers et al. 2006). For the 25 modern mines in the United States selected for detailed case study, 100 percent of mines predicted compliance with water quality standards, but 76 percent of mines exceeded water quality standards as a direct result of mining, and 64 percent of mines employed mitigation measures that failed to prevent water contamination (Kuipers et al. 2006; Maest et al. 2005; Woody et al. 2010). Predictions made about surface and groundwater quality impacts without considering the effects of mitigation appear to be more accurate than those that take mitigation into account (Jennings et al. 2008; Kuipers et al. 2006).

While NEPA analyses have not yet been completed for the potential mines in the District, Ambler Metals (formerly Trilogy) has completed a Preliminary Feasibility Study (PFS) for the Arctic Project and has funded multi-year aquatic biomonitoring studies at the Arctic and Bornite prospects (Trilogy 2018a). Results of water quality, fish, aquatic invertebrate, and periphyton sampling and fish tissue analysis are presented in Bradley (2017, 2018), Clawson (2022 and 2023), and Trilogy (2018a).

In its technical report for the PFS, Ambler Metals indicated that selenium concentrations are predicted to be high in process water and waste rock runoff at the Arctic Mine and that water treatment is unlikely to remove appreciable amounts of selenium (Trilogy 2018a). Selenium has emerged as a contaminant of concern in mining industries as its disturbance to both aquatic and terrestrial ecosystems has become more evident (Etteieb et al. 2020). While selenium is a naturally occurring chemical element that is nutritionally essential to fish and aquatic life at small amounts, it is toxic at levels only slightly higher

[56] Hancock (2002) provides an easy-to-understand description of hyporheic zone function and summarizes potential impacts from human development.

[57] Groundwater exchange in hyporheic zones can help keep fish eggs from freezing in Alaska during the coldest part of winter and provide winter habitat (State of Alaska Cooperating Agency Team technical comments on the Ambler Road Draft EIS [BLM 2019]).

(EPA 2016; Young et al. 2010). While high concentrations of selenium can cause acute toxicity in fish, the most harmful effects to aquatic life result from chronic exposure of lower concentrations through bioaccumulation[58] (EPA 2016; Etteieb et al. 2020). To protect against chronic exposure, the EPA (2016) developed the *Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater, 2016* based on selenium concentrations in fish tissue and in the water column. The treatment of mine water that contains selenium is challenging due primarily to its complex chemistry and speciation (Etteieb et al. 2020). Given the challenges in treating mine effluents with harmful levels of selenium, often a combination of monitoring and treatment methods are used as preventative measures to reduce concentrations and impacts to aquatic life and potentially human life (Etteieb et al. 2020).

As of 2018, Ambler Metals (formerly Trilogy) proposed to manage selenium by discharging the combined effluent directly into the Shungnak River via an 11-kilometer (6.8-mile) pipeline (Trilogy 2018a). Trilogy (2018a) predicted that water quality in Shungnak Creek below the discharge point would meet water quality criteria after a mixing zone, although the length of the mixing zone or levels of selenium concentrations are not identified. Discharging high levels of selenium into the Shungnak River could have detrimental effects to aquatic life. Ambler Metals has stated that obtaining a permit to approve the discharge of selenium into the Shungnak River is a regulatory risk for their project (Trilogy 2018a). Ambler Metals recommended several additional studies be conducted at the potential Arctic Mine site (Trilogy 2018a). Among these is evaluating the size of the mixing zone that would be necessary on the Shungnak River to meet stream selenium water quality limits (Trilogy 2018a). Diffuse mining-related pollution in streams, due in part to altered water tables, contributes to the loading of metals and other potentially harmful constituents (Younger 2000, as cited in Limpinsel et al. 2017). The introduction of metal and mineral-rich runoff, particularly from acid mine drainage, can impact the ecology of entire watersheds (Limpinsel et al. 2017). Acid mine drainage is toxic to fish, algae, zooplankton, and aquatic invertebrate populations at the ecosystem, metabolic, and cellular levels (Limpinsel et al. 2017).

Subsistence harvesters using the Kobuk River watershed depend on healthy fish and wildlife populations. If acid mine drainage were to affect fish in the watershed, humans that consume affected fish could be exposed to toxins concentrated in fish tissues (NEJAC[59] 2002). Researchers suggest that proximity to water increases the risk factor of potential water quality impacts, especially for mines with moderate to high acid drainage or contaminant leaching potential (Kuipers et al. 2006). Based on review of other mines in the United States, a recent study suggests that standard waste rock mixing and segregation practices that are employed as mitigation measures to minimize potential impacts may not prevent impacts to water resources where acid-generating materials are present (Kuipers et al. 2006). The mining industry has spent large sums of money to prevent, mitigate, control, and stop the release of acid mine drainage using the best available technologies, yet acid mine drainage continues to be one of the greatest environmental liabilities associated with mining, especially in pristine areas (Jennings et al. 2008). However, ADNR, in its role as a cooperating agency for this Supplemental EIS, noted that, under 11 AAC 97.240, an operation must reclaim mine waste in a manner that either prevents acid mine drainage or prevents the off-site discharge of acid mine drainage.

The number of serious tailings dam failures have increased markedly since the 1960s; researchers report 72 tailings dam failures in the United States between 1960 and 2000 (ICOLD 2001, as cited in Hughes et al. 2016) and 33 major mine tailings dam failures between 1960 and 2000 (EPA 1995, as cited in Hughes et al. 2016). After several dams failed in Alaska during the 1970s, the state adopted laws to regulate the

[58] Consumption of fine particulate organics and some inorganics by primary consumers, typically invertebrates and small fish, is the primary pathway for selenium entry into aquatic food webs (Young et al. 2010).
[59] The National Environmental Justice Advisory Council is a Federal Advisory Committee to the EPA.

construction of dams in Alaska. Compliance with ADNR's Alaska Dam Safety Program[60] would presumably be required prior to receiving authorizations to construct and operate a tailings dam[61] in Alaska[62] (ADNR 2017). The *Guidelines for Cooperation with the Alaska Dam Safety Program* details those requirements (ADNR 2017).

Toxic dust from open pits, roads, and processing facilities can result in the contamination of aquatic habitat and contribute to the bioaccumulation of toxins, such as PAHs and heavy metals, in fish tissue. PAHs can be found in gasoline and diesel vehicle exhaust, fuel spills and leaks, and in dust shed during vehicle wear (Wang et al. 2016). Organisms are then exposed to these contaminants via uptake from sediments by aquatic microbes, plants, and benthic-living and filter-feeding invertebrates (Poteat and Buchwalter 2014). These compounds are toxic to fish, amphibians, and aquatic invertebrates and are known to bioaccumulate through trophic levels (Fisher 1995). Fish and aquatic species consume the lower trophic level organisms, and the toxins then remain in the environment and bioaccumulate up trophic levels over time (Fisher 1995). Consumption of fish contaminated with PAHs may constitute human health risks if populations are exposed to hazardous levels, which can vary by duration of exposure, concentration of PAHs, and amount and type of food consumed (European Commission 2002; Wickliffe et al. 2014).

Several mines have employed mitigation measures in an effort to minimize potential impacts from toxic dust. Studies show that even with the use of hydraulically sealed lids, truck rinsing procedures, and several other minimization measures, ore concentrates can be transported up to 2.5 miles (4 kilometers) from the Red Dog Mine haul road and low levels much farther (Hasselbach et al. 2005; Neitlich et al. 2017). Toxins released into the environment would enter aquatic habitats and bioaccumulate in fish tissues, as discussed above. While mitigation measures would help to minimize the severity of impacts, total avoidance of impacts to fish habitat from toxins generated during mining operations may not be possible. Of particular concern is the potential Sun Mine site's location within the Beaver Creek drainage, which flows directly into the Kobuk River sheefish spawning grounds.

The Alatna River is the most important spawning area for sheefish and other whitefish species in the upper Koyukuk River drainage (Brown 2009). If any 1 of the 4 most advanced, large-scale mines were developed, there would be an influx of people into the region. To accommodate this change, additional commercial flights could be added at lower costs, which may make recreation more inviting in this area. An increase in recreational fishing has the potential to affect subsistence harvest. While access aside from industrial use is not being considered, fishing pressure could impact the sheefish population and availability of this species for subsistence harvest if that were to change in the future. Reasonably foreseeable routes and roads established off of the proposed road, as well as the increase in traffic from commercial goods, may expand the fugitive dust zone and increase sedimentation and the potential for spills. Additionally, mine haul roads, such as the reasonably foreseeable spur roads in the Kobuk River watershed, can impact fish habitat via fugitive dust, contamination of roadside vegetation with heavy metals, and road runoff (Trombulak and Frissell 2000). Road construction that increases fugitive dust levels or disturbs river channel stability has the potential to negatively impact sheefish spawning and rearing habitat, particularly in association with the Sun prospect, which drains into known sheefish spawning habitat in the Kobuk River. Juvenile sheefish may also experience decreased feeding success because of increased turbidity from road dust and declines in invertebrate abundance. Fugitive dust may also cause early snowmelt (Walker and Everett 1987), which could result in an increase in soil

[60] The mission of the Alaska Dam Safety Program is to protect life and property in Alaska through the effective collection, evaluation, understanding and sharing of the information necessary to identify, estimate, and mitigate the risks created by dams.
[61] The Alaska Dam Safety Program regulates any dam that impounds 50 acre-feet or more and is 10 feet high; is 20 feet high; or would threaten lives and property if failed (ADNR 2003).
[62] AS 46.17.020 requires ADNR to employ a professional engineer to "supervise the safety of dams and reservoirs" in Alaska."

temperatures, rapid decomposition of organic matter, and potentially hypoxia in shallow waterbodies and pools in wetlands.

Development of mines as a result of any action alternative would lead to increased traffic on the existing road system between the Dalton Highway turnoff and the Alaska Railroad yard in Fairbanks (see Table 25). Increased traffic in these areas would increase the potential for contaminants by way of roadway runoff and accidental spills into streams crossed, including the accidental spills of toxic, mine-related chemicals, ore, or wastes. Indirect impacts to fish could result from road maintenance, such as grading, snowplowing, and deicing, potentially introducing additional toxins or sediment into streams and wetlands. Upgrades to existing culverts and bridges along the Dalton Highway may improve habitat and passage conditions in the affected stream systems.

Construction of any of the action alternatives would reduce connectivity to and degrade the quality of habitat that supports salmon, sheefish, broad and humpback whitefish, burbot, Arctic grayling, northern pike, Alaska blackfish, and several other fish species as a result of modifying drainage patterns and installing conveyance structures in more than 1,000 streams[63] across more than 200 miles of the project area. Appendix E, Chapter 3 Biological Resources Tables and Supplemental Information, Table 15, identifies fish species that may be affected. Several studies show that habitat downstream of culverts contains more fine sediment, less dissolved oxygen, and increased water temperatures as compared to habitat in streams crossed by bridges. Tanner (2008) found that spawning occurred in areas of the Selawik River with low slopes and high sinuosity, areas that are particularly susceptible to sediment accumulation and loss of bed stability from road construction. A recent study of fish assemblages and habitat at industrial road crossing sites in the boreal forest found that culverts often create changes in species composition and fish density both upstream and downstream (Maitland et al. 2016).

To reduce the likelihood and severity of potential impacts to fish and aquatic life, AIDEA has committed to using stream simulation design principles per USFS (2008) guidelines for all culverts placed in streams that support resident or anadromous fish. While physical habitat alteration within a given stream may be fairly localized, the project would affect more than 1,000 mapped streams, so impacts would be widespread. AIDEA's design commitments (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) would minimize, but not eliminate, adverse impacts to fish and aquatic habitat. While AIDEA proposes to provide fish passage for all perennial streams and those well-defined ephemeral streams determined to support fish, the road embankment would change overland flow, change surface and groundwater flow patterns, and in some cases, it would cut off or reduce access to wetland and low-lying off-channel habitats (e.g., seasonally flooded areas) that may support rearing and feeding fish seasonally (Creamer 2019; Daigle 2010; Forman and Alexander 1998; Trombulak and Frissell 2000). USACE special conditions 5 through 12, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), include measures to protect anadromous fish and aquatic habitat.

AIDEA assumes that all perennial rivers and streams provide fish habitat and that some well-defined ephemeral streams likely provide fish habitat (see AIDEA's SF299). AIDEA proposes to provide fish passage at all crossings of perennial and well-established ephemeral channels that support fish using stream simulation design principles (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA; Appendix E, Table 16). AIDEA made an estimate at the application stage of the number of major, moderate, and minor culverts that would be needed for the project. The moderate culverts, major culverts,

[63] Based on spatial review of alternatives' crossings of streams in the NHD AWC and streams mapped by DOWL and assumed by AIDEA to support fish habitat (received GIS data in 2019). Wetland and stream mapping produced by DOWL (2014) was based on aerial photograph interpretation, site photographs, Lidar 2-foot contours, and 1:24,000-scale hydrologic stream data. DOWL (2014) cautions that densely vegetated habitats precluded the identification of some small drainages (less than 12 feet wide). Additional field data collection would be necessary to document all streams.

and bridges proposed would likely satisfy State of Alaska's fish passage requirements; however, additional site-specific information may be necessary during the permitting stage to refine design. Most culverts in AIDEA's application are identified as minor culverts (i.e., 3 feet or less in diameter). AIDEA proposes to use minor culverts to cross perennial and ephemeral streams, maintain hydrologic continuity between wetlands, and facilitate cross-drainage. In some cases, 3-foot-diameter culverts may not be large enough to provide fish passage, particularly given that stream simulation design would be used for all fish passage culverts, per AIDEA's design commitment (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). However, ADF&G would likely require that additional surveys be conducted at stream crossings, particularly where fish data are lacking, to inform culvert design during permitting.[64] At the construction stage, AIDEA would be required to use culverts designed appropriately for the drainage and to meet fish passage requirements where necessary, even if their application stage estimate was different. Without regional-specific data regarding distribution of fish species, in the absence of data showing fish are not present, AIDEA assumes that fish are present in all waterbodies. Assuming that culverts are designed and maintained to allow fish passage during natural migration periods, impacts from conveyance structures may be localized within a given stream but widespread across the region since the road would traverse hundreds of small and large fish streams. If culverts did not maintain hydrology and fish passage, adverse impacts to fish species abundance, distribution, and potentially populations would result. Properly employed design features (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA) and potential mitigation measures (as described in Appendix N) would minimize, but not eliminate, potential impacts to fish and aquatic species related to road construction, operation, and maintenance.

Gravel mining in floodplains would negatively affect aquatic habitat and may affect egg survival rates in nearby spawning habitats. Management plans for the existing Indian River and Hogatza River ACECs[65] indicate that material sites should not be located in the active floodplain of any stream within these ACECs. Appendix N outlines a potential mitigation measure to prevent material extraction within an active floodplain on BLM-managed lands; additionally, the USACE applied a special condition to the project's Section 404 permit, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), prohibiting gravel mining from streambeds, riverbeds, active floodplains, lakeshores, and lake outlets. On lands outside of BLM jurisdiction, prohibiting material sites in active floodplains would minimize impacts to fish habitat from gravel mining and reduce the project's cumulative impact to fish and aquatic life. The road and associated infrastructure have the potential to degrade habitat quality and may affect populations of salmon, whitefish, and other species in this region. The potential for the road to accelerate the predicted rate of climate-driven permafrost degradation, which would further degrade downstream water quality, potentially inhibit fish movement, and may alter species distribution and abundance, is also of concern (Evengard et al. 2011; Moquin and Wrona 2015; O'Donnell et al. 2017). Constructing and maintaining roads and other infrastructure built on thawing permafrost is poorly understood (Ljunggren and Rocha 2011, as cited in Limpinsel et al. 2017). However, with appropriate thermal modeling prior to road construction, and compliance with the project's SWPPP, some impacts from permafrost degradation and associated effects may be reduced.

The action alternatives and RFAs may further exacerbate ongoing changes to the landscape, such as accelerating permafrost thaw, reducing fish habitat quality, and changing water temperature regimes. Climate change is predicted to continue impacting freshwater fish habitat availability, quality, and

[64] The Fishway Act (AS 16.05.841) requires ADF&G authorization for activities within or across a stream, including ephemeral streams, used by fish if such an activity may impede the efficient passage of resident or anadromous fish.
[65] The *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) identifies areas having values requiring levels of protections above those normally afforded under public land management. Indian River and Hogatza river tributaries (combined watershed of Clear, Caribou, and Bear creeks) were designated in the plan for the protection of aquatic habitat.

connectivity within and beyond the project area. Alaska has been experiencing warmer air and water temperatures, changing precipitation patterns, altered stream flows; increased permafrost thaw and fire regimes, loss of sea ice, changes in ocean salinity, and increased coastal erosion as a result of climate change (Wrona et al. 2006; Clark et al. 2010).

Impacts to freshwater fish populations as a result of climate change appear inevitable, and outcomes such as range shifts, thermal stress, reduced survivorship, reduced production, and local extirpation are possible (Reist et al. 2006; Wassmann et al. 2010; Wrona et al. 2006). Thawing permafrost would potentially result in roadway embankment damage or changes in culvert inverts or alignments during the life of the project. Roads built on thawing permafrost could collapse and potentially increase the likelihood of accidents and impacts associated with spills (Limpinsel et al. 2017). However, regular maintenance would minimize the potential for such impacts. Reduction in habitat connectivity between streams and wetlands due to installation of culverts and climate-induced fluctuations in water levels can negatively impact fish species at all life stages and reduce foraging success and production (Prowse et al. 2006). Arctic freshwater ecosystems are complex and predicting the exact ways in which the road would impact the landscape and developing mitigation strategies to ameliorate the impacts are especially challenging given the data currently available.

The road could accelerate the predicted rate of permafrost thaw, which would further reduce downstream water quality, potentially inhibit fish movement, and may alter species distribution and abundance (Arp et al. 2019). Fish response to climate change will vary by species and type of habitat affected, among other factors (Reist et al. 2006). USACE special conditions 13 through 15, which the BLM has adopted as proposed mitigation measures (see Appendix N, Section 3.5), include measures to protect thaw-sensitive permafrost soils.

Permafrost thaw results in increased nutrient, sediment, and carbon loading in rivers and lakes (Vonk et al. 2015; Wrona et al. 2006). Continued warming and permafrost thaw would likely promote or accelerate the mobilization of bioavailable methylmercury into aquatic habitats and the food chain[66] (Schuster et al. 2011). Climate-driven changes to the interrelated temperature and hydrologic regimes of Alaska's freshwater in response to warmer conditions, predicted to be substantial within the life of the road, would affect the timing of life history events (e.g., spawning, emergence) and the ability of habitat to support some species, and would ultimately change species distribution and affect the productivity of individual stocks and species populations (Clark et al. 2010; Mauger et al. 2016). Warming water temperatures could limit the distribution of fish that require cold thermal regimes, such as whitefish species and Alaska blackfish, due to a decrease in the availability of suitable habitats (Clark et al. 2010). Others, including some Pacific salmon, may be capable of expanding distributions farther north (Clark et al. 2010). In some systems, warmer conditions may increase fish production for some species but may create conditions unsuitable to support others (Clark et al. 2010; Mauger et al. 2016). Warmer winters may cause Pacific salmon to hatch earlier in the season, potentially before adequate food sources would be available (Clark et al. 2010). The loss of habitat (e.g., decrease or lack of water) during critical life stages that would result from the loss of glaciers and snowpack would adversely affect Arctic grayling and other species, and potentially affect the success of Pacific salmon spawning in large glacial river systems (Clark et al. 2010). In more extreme cases, prolonged warm water coupled with low water levels may lead to mass salmon die-offs (Mauger et al. 2016). Warming water temperatures could also increase disease vectors (Clark et al. 2010), increase fish vulnerability to disease (Fryer and Pilcher 1974; Kocan et al. 2004), and reduce swimming performance (Mauger et al. 2016). Fish response to climate change would vary by species and type of habitat affected, among other factors (Reist et al. 2006).

[66] Methylmercury, which is known to be the most poisonous among the mercury compounds, is created when inorganic mercury circulating in the general environment is dissolved into freshwater and seawater (Hong et al. 2012).

While Pacific salmon are resilient, under current conditions, many Pacific salmon stocks appear stressed by a number of factors (Larson et al. 2017). Chinook and chum salmon returns to the Yukon River basin and other systems in northwest Alaska have declined since the late 1990s (McKenna 2015) and the resulting restrictions on the harvest of Chinook salmon have increased harvest of chum salmon (McKenna 2015; Larson et al. 2017). During the years since publication of the Ambler Road Final EIS (BLM 2020), Chinook, summer chum, and coho salmon populations have seen continued, marked declines in abundance (JTC 2022). Scientists suspect that heat stress from the warmer than normal water temperatures and low water levels is what caused thousands of adult chum salmon in the Koyukuk River to die prior to spawning in 2019 (Westley et al. 2019; Quinn-Davidson 2019). Many stocks of Pacific salmon in Alaska, including within the project area, appear to be declining due to several factors such as overfishing, warming ocean conditions, interspecies competition, and even changes in spawning habitat. It is difficult to assess at what point individual impacts may cumulatively stress fish, including Pacific salmon, to the point that effects to local and regional populations cumulatively affect species' resilience.

There is a long-term potential that the Ambler Road is increasingly used by the public, both lawfully and illegally (see Appendix H, Section 2.2, Road Access Scenarios, for details on potential changes in road access and use). The Ambler Road would allow for commercial deliveries to local communities using authorized operators (i.e., road-specific licensed drivers), which would result in new road and trail connections between communities and the road that would impact fish and aquatic species directly and indirectly. New roads or trails may alter stream or creeks at crossing points, result in increased sedimentation, and create changes in riparian habitat. Community commercial access would also result in a marginal increase over anticipated industrial road traffic volumes along the length of the road, increasing fugitive dust deposition along adjacent wetlands and waterbodies.

Authorized public access of the road following mine closure would result in additional direct impacts to fish and aquatic habitats as the road would likely require additional improvements or modifications to make the road safe for public use, including bringing the roadway up to DOT&PF standards (e.g., curve radii, slope limits). Local access to the Ambler Road and potential trespass actions could directly impact fish and aquatic habitat as new connecting roads or trails are established, likely crossing streams and creeks and causing direct damage to banks and beds, sedimentation, and impacts to riparian vegetation. Additional road traffic would also require increased road maintenance (e.g., grading, snowplowing, deicing), which could increase sediments in streams and adjacent wetlands.

Increased traffic volumes would add to the cumulative indirect impacts resulting from road use (e.g., fugitive dust deposition into adjacent waterbodies, accidental spill risks). Most impacts to fish from trespassers would come directly from fishing activity. Increased activity may directly impact spawning and rearing habitat by disrupting spawning gravels or changing local hydrology. These activities may also create unintended competition for resources between subsistence users and the public, creating additional strains on local fish populations.

The road, reasonably foreseeable future development, and climate change would affect individual fish in localized areas and have the potential to affect the resilience and strength of fish populations across the region. Climate change would further intensify and likely accelerate human-caused changes to habitat throughout the project area resulting from the project and reasonably foreseeable future actions. Proper construction and management would minimize, but not eliminate, the potential for the road and reasonably foreseeable future development to adversely affect fish populations in this region. Cumulatively, the project has the potential to cause substantial, long-term impacts to fish and aquatic life that could lead to substantial impacts on subsistence use practices in the region, even with mitigation measures in place. Sheefish and other whitefish species may be most vulnerable to such impacts since large numbers of fish spawn in relatively small, geographically distinct areas. However, water quality

impacts have the potential to cause major changes in the distribution and abundance Pacific salmon and other important fish species in this region. The Chinook salmon population has been declining for decades for unknown causes, and restrictions on Chinook salmon harvest have resulted in increased harvest of chum salmon in the Yukon River basin (McKenna 2015; Larson et al. 2017). In 2019, thousands of adult salmon died, prior to spawning, in streams throughout Alaska, likely due to the warmer than normal water temperatures (Westley et al. 2019; Quinn-Davidson 2019).[67] Scientists estimate that thousands of adult salmon in the Koyukuk River died from heat stress prior to spawning in 2019 (Westley et al. 2019; Quinn-Davidson 2019). While Pacific salmon species are resilient, it is difficult to assess at what point individual impacts may tip the balance and cumulatively stress fish to the point of causing population-level affects or cumulatively affecting species' resilience. Further, Pacific salmon are an important prey species for bears and other carnivores, as well as other fish species, through the direct consumption of migrating adults, deposited eggs, carcasses, and juvenile fish (Gende et al. 2002). The decomposition of their carcasses also provides marine-derived nutrients to the aquatic and terrestrial environments throughout the landscape, supporting primary production in lakes and streams, and riparian vegetation growth (Cederholm et al. 1999; Schindler et al. 2003). Thus, reduction in salmon populations leading to a decline of available marine derived nutrients could have broad-scale impacts on the ecosystem throughout the project area.

3.3.3 Birds*

Affected Environment

Approximately 143 avian species may occur in the project area (see Appendix E, Table 17). The majority of avian species are migratory and present only in summer or during migration. Approximately 20 year-round resident species occur in the project area, including owls, ravens, ptarmigan, grouse, chickadees, and American dippers (see Appendix E, Table 17; ADF&G 2019b). Approximately 131 species, including these resident species, nest within the project area. There is little information on avian species distribution or abundance in the project area, and researchers have completed few avian monitoring studies in this region (Handel et al. 2021).[68] The ACCS Wildlife Data Portal interactive range maps (ACCS 2019b), supplemented with species lists and survey reports from GAAR (DeGroot and McMillan 2012) and Kanuti NWR (Craig and Dillard 2012, 2013; Harwood 2023; Platte and Stehn 2011) and with nearby breeding bird survey routes (Caribou Mountain, Kanuti Canyon, Manly Hot Springs, Moose Creek; see Pardieck et al. 2018), inform bird species occurrence in the study area. These studies are incorporated by reference. A wetlands functional assessment and wildlife habitat evaluation of a portion of the Kobuk River Preserve unit of GAAR (part of Alternative A) that was prepared for AIDEA was used to describe the relative importance of wildlife habitats to bird species (Ives and Schick 2017).

The project area includes 3 ecoregions (see Appendix E, Section 1.1.1, Table 2) and 15 vegetation types (see Appendix E, Section 1.1.1, Table 3) that represent a wide diversity of avian habitats. The proposed road corridors lie within Bird Conservation Region (BCR) 4, the Northwestern Interior Forest, near the eastern border of BCR 2 (Western Alaska) (Handel et al. 2021). Avian species assemblages in the project area vary depending on vegetation/habitat type and elevation. As part of wetlands and riverine functional assessments, biologists evaluated bird habitat use for the portion of the Kobuk River Preserve unit of

[67] Heat stress during spawning migration has the potential to cause substantial pre-spawn mortality of adult fish (Gilhousen 1990; USGS 2020). Climate models have for years predicted that water temperatures in Alaska would warm to unhealthy temperatures for salmon, so for those reasons the salmon deaths in 2019 were not a surprise (Westley et al. 2019).

[68] Impacts to birds were not identified as a significant issue based on scoping comments. Based on the species known to inhabit the study area, and the habitat information that is available inferred from vegetation and other mapping, The BLM determined there is sufficient information to make a reasoned choice among alternatives. The cost of obtaining detailed data on species distribution and abundance for 142 species in a project area of this size would be exorbitant.

GAAR (part of Alternative A) (Ives and Schick 2017). Forested wildlife habitats[69] (riverine mixed forest, riverine spruce forest, upland and lowland mixed forest, and upland and lowland spruce forest) in this area are expected to support the greatest number of bird species due to their greater diversity of vegetation structure, which provides habitat to primarily landbirds. The variation in hydrology and closeness to surface water in these habitat types provide habitat for some waterbirds and shorebirds. Habitats with simpler vegetation structure, such as tall-grass types (riverine grass-shrub meadow, upland and lowland grass-shrub meadow), are expected to support fewer numbers of bird species. Waterbirds, shorebirds, and larids comprise the majority of species found in wetter habitats, such as wet sedge-shrub meadows. Alpine and arctic tussock tundra and alpine dwarf shrub tundra support a lower density of breeding birds, and species found in alpine and tundra ecoregions tend to be specialists with strong associations with particular habitat types (Tibbets et al. 2005).

Approximately 33 species of waterbirds, including waterfowl (27 species), loons (3 species), grebes (2 species), and cranes (1 species) may occur in the project area (see Appendix E, Table 17). Most waterbirds are associated with lakes, streams, and wetlands, which are common throughout the project area (see Appendix E, Table 5). The most common waterbirds recorded during aerial surveys in Kanuti NWR include northern pintail, scaup (greater or lesser), and American wigeon (Platte and Stehn 2011). The Central Yukon REA (Trammel et al. 2016) identified areas of waterfowl species richness near the Hogatza and Pah rivers. Red-throated loons are currently listed by the BLM as a sensitive species (BLM 2019), and observations of the species have been uncommon in the project area (eBird 2023). They breed in tundra wetlands and small boreal ponds but prefer coastal areas (Barr et al. 2000).

Approximately 17 species of shorebirds and 6 species of larids (gulls, terns, and jaegers) may occur in the project area. Half of the expected larid species and 15 of 17 shorebird species are listed as rare by ACCS or Kanuti NWR (see Appendix E, Table 17). Most shorebird species occur in wetlands and in suitable habitat along rivers, streams, ponds, and lakes; combined, freshwater wetlands and waterbodies comprise nearly 14 percent of the assessment area (see Appendix E, Table 5; Map 3-9). Some species, such as American golden-plover, wandering tattler, whimbrels, and surfbirds breed in alpine tundra and mountainous areas; the alpine arctic tussock tundra and alpine dwarf shrub tundra vegetation types, which include suitable nesting habitat for these species, comprise approximately 20 percent of the assessment area (see Appendix E, Table 3). Alternative C crosses mountainous and alpine habitats, while Alternatives A and B skirt the edges of these habitats. Wandering tattlers and surfbirds are both rare, and their population trends are unknown due to their small population size and wide distribution. Shorebird species that breed in the boreal forest, such as solitary sandpiper and lesser yellowlegs, have shown steep population declines across North America during the past 2 decades (ASG 2019; USFWS 2008). As with other shorebird species that nest in the boreal forests, little is known about their breeding distribution and habitat associations, and few inventories of lowland-breeding shorebirds have been conducted (ASG 2019).

Approximately 18 raptor species may occur in the project area, including eagles (2 species), hawks (6 species), falcons (4 species), and owls (6 species). Aerial surveys in the Kanuti NWR identified bald eagle, osprey, great horned owl, and northern goshawk nests (Craig and Dillard 2012, 2013). During 2013 aerial raptor nest surveys within 2 miles of the Alternative A and B centerlines, researchers identified golden eagle, peregrine falcon, osprey, and bald eagle nests (Ritchie 2013). The majority of these nests (75 percent) occurred within 2 miles of the centerlines for Alternatives A and B. The foothills along and north of Alternatives A and B contain suitable nesting habitat for primary cliff-nesting species (peregrine falcons and golden eagles), mainly in the foothills of mountain ranges in the project area. Peregrine

[69] Wildlife habitat classes were aggregated from Integrated Terrain Unit mapping data; see the Methods section of Ives and Schick (2017) for descriptions.

falcons and rough-legged hawks may also nest in relatively small, riverine banks along the major rivers crossed by project alternatives. Major river drainages (e.g., Alatna, Reed, Kogoluktuk, Jim, Koyukuk, Shungnak, and Mauneluk rivers and Beaver Creek) and some lakes provide riparian forest stands suitable for bald eagles and osprey, the primary tree-nesting species in the project area. Surveys focused on cliff habitat and large, riparian tree stands (Ritchie 2013), and raptor species that use different habitats such as upland forest or scrub were not detected.

Approximately 68 species of landbirds, including passerines (57 species), woodpeckers (5 species), kingfishers (1 species), and grouse/ptarmigan (5 species) may occur in the study area. In 2005, researchers conducted landbird monitoring in the southern GAAR. The most common species observed were fox sparrow, Bohemian waxwing, white-crowned sparrow, dark-eyed junco, ruby-crowned kinglet, and redpolls (Tibbitts et al. 2005). This is consistent with other landbird surveys elsewhere in Interior Alaska (ABR 2014; Harwood 2014). Common ravens are the largest passerine, filling a niche similar to raptors, and are ubiquitous across most of Alaska. Ritchie (2013) identified 6 common raven nests located within 2 miles of Alternatives A and B.

Four species of landbirds that may occur in the study area are currently on the BLM sensitive species list: olive-sided flycatcher, gray-headed chickadee, Smith's longspur, and rusty blackbird (BLM 2019). Olive-sided flycatchers breed in low densities across BCR 4 (Handel et al. 2021) and can be found in open forests, particularly along forest edges, such as burns, marshes, open water, and open woodlands. They sing from the tops of tall, prominent trees and forage among snags and over meadows (Altman and Sallabanks 2012). The *lanthami* subspecies of gray-headed chickadee is endemic to Alaska and northwestern Canada and is 1 of 3 resident chickadee species found in mixed coniferous and deciduous forests of the project area (Booms et al. 2020). Gray-headed chickadees were once considered locally common in parts of interior Alaska; however, the species' distribution has contracted, and its population has declined during the past 2 decades (Booms et al. 2020). Smith's longspurs primarily breed in moist upland tundra and shrub habitats of the Brooks Range and foothills and depend on a unique configuration of tundra sedge and shrub vegetation types (Handel et al. 2021). Rusty blackbirds breed in wetland and riparian habitats, such as bogs, muskeg swamps, and beaver ponds (Avery 2020).

Special Status Species

The Migratory Bird Treaty Act (MBTA) protects all migratory birds in the project area and prohibits take (including killing, capturing, selling, trading, transport) of birds, nests, and eggs without prior authorization from the USFWS. The Bald and Golden Eagle Protection Act provides additional protections for bald and golden eagles. The ESA protects TES. The BLM has confirmed with the USFWS (Swem 2020) that no ESA-listed threatened, endangered, or candidate bird species and no designated critical habitat currently occurs in or near the study area. The status of species is subject to change as new data on population abundance, trends, and recovery is available, and some agencies update their lists on a regular basis (e.g. the BLM updates its sensitive species list every 3 years).

Of the 143 bird species that may occur in the project area (see Appendix E, Table 17), 7 are currently recognized by the BLM as sensitive species; 7 are BLM watchlist species (BLM 2019); 10 are USFWS birds of conservation concern USFWS 2021); and 49 are recognized as "at-risk" by ADF&G (2015). Appendix E, Table 17 also includes listings by the International Union for Conservation of Nature (IUCN 2019), Audubon Alaska (Warnock 2017a, 2017b), and Boreal Partners in Flight (Handel et al. 2021).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the BLM and/or other federal permitting agencies would not issue authorization for the Ambler Road, and therefore there would be no impacts on birds resulting from road construction and use. If the No Action Alternative is selected, mineral exploration would continue to be supported by aircraft, which could impact birds present in the area; however, as described in Appendix H (Section 2.3.3) the continued lack of surface access to the District may also reduce interest in mining exploration and associated air traffic.

Impacts Common to All Action Alternatives

Under all action alternatives, the impacts of road construction on birds would include direct and indirect loss and alteration of terrestrial and aquatic habitats, disturbance and displacement, and injury or mortality. The avian species affected would vary based on the available habitat types under each action alternative. However, due to limited baseline data on bird distribution and abundance in the project area, it is not possible to quantify potential impacts to most birds at the species or population level. Avian abundance across North America has declined 29 percent since 1970 (Rosenburg et al. 2019). Continent-wide, shorebirds have shown some of the steepest declines during the past 4 decades (1980–2019), with over half of monitored species losing at least 50 percent of their abundance (Smith et al. 2023). Analysis of long-term (1993–2015) and short-term (2003–2015) population trends of 84 bird species using Breeding Bird Survey (BBS) data indicate that many species breeding in the Northwestern Interior Forest (BCR 4) are experiencing significantly negative population trends (Handel and Sauer 2017). Most of the species experiencing declines were associated with moist or wetland forest habitats and included waterfowl (Canada goose, red-necked grebe), shorebirds (lesser yellowlegs), and landbirds (olive-sided flycatcher, western wood-peewee, alder flycatcher, and all 3 species of swallows occurring in the project area).

Habitat loss and alteration

Direct habitat loss and alteration would occur during all phases of road construction, including gravel mining and construction of a seasonal ice road to support Phase 1 (pioneer road) construction. Reclamation would be conducted with the intention of restoring the disturbance footprint to near current conditions, but the timing of reclamation would vary across the route based on numerous factors, including topography, hydrology, and vegetation types used in reclamation. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Placement of ice or snow for a winter construction access trail (snow/ice roads and ice bridges) used to support Phase 1 road construction would directly alter bird habitats in the project area. Habitat alteration can occur through vegetation removal and damage, including removal of trees and tall shrubs, reduced live and dead cover due to crushed standing plant cover, stem and blade breakage, compaction, freezing, and physical damage (see Section 3.3.1, Vegetation and Wetlands). Although recovery of sedges, grasses, and forbs may occur in 2 to 3 growing seasons (Pullman et al. 2005), tussocks, woody shrubs, and trees take longer to recover (Yokel et al. 2007). Studies of the effects of ice roads on North Slope vegetation indicate that vegetation damage is most severe and takes longer to recover in well-drained areas, including moist tundra and shrub habitats, which support higher densities of passerines, ptarmigan, and some shorebirds, like whimbrel and American golden plover. In contrast, aquatic and wet tundra habitats, which are favored by most waterbird species, generally are damaged less by ice roads and recover more quickly (Guyer and Keating 2005; Pullman et al. 2005; Raynolds et al. 2020). Bird habitat alterations

from ice roads and pads are likely, and their impacts to bird abundance and community compositions could be short or long term, depending on the types of vegetation affected and whether ice road routes and pad sites are reused in multiple years.

Vegetation removal and gravel fill placement for all phases of road construction and maintenance would result in direct loss of breeding, nesting, foraging, staging, and stopover habitat for birds. It is likely that most, if not all, species now occurring in the area of the proposed alignments would continue to occur in the area. Individuals would be displaced, and some may not be able to successfully compete to find suitable replacement habitat (e.g., for nesting or foraging) or would end up in inferior habitat (e.g., more subject to flooding or predation). Phase 3 construction requires longer culverts than those needed for Phases 1 and 2. This would result in additional habitat alteration that disproportionately affects lowland and wetland habitats and species depending on those areas, such as waterbirds and shorebirds. Rare, habitat-limited, and specialist bird species, such as some special status species and birds with high fidelity to nest sites, could be disproportionately affected by habitat loss. The removal or alteration of uncommon habitat types would have a proportionately greater impact on the species that use them; however, the impact would be localized. During bridge construction, abutment installation is likely to alter some bluffs and cliffs, and the impact to breeding raptors is discussed by alternative below.

Gravel mining and the creation of material stockpiles have the potential to create nesting habitat for the bank swallow, which is listed by the BLM as a watchlist species (BLM 2019) and a Common Bird in Steep Decline by Boreal Partners in Flight (Handel et al. 2021). Bank swallows typically nest in eroding slopes and cutbanks along rivers and lakes, but they have adapted to human-modified habitats and often nest in sand and gravel pits and along industrial roads (Ontario Ministry of Natural Resources and Forestry 2017). Creation of vertical slope faces in sand and gravel pits or the road embankments could attract bank swallows to nest in these areas where project activities such as gravel or sand extraction and road construction occur. This could result in nest failure or mortality of adult birds, eggs, and/or nestlings. Potential BLM Mitigation Measure 2, in Section 3.3.4 of Appendix N, protects bank swallows by ensuring that no vertical or near-vertical faces that may encourage bank swallow nesting are left on any slope, including material stockpiles, on BLM-managed lands (see Appendix N, Section 3.3.4, Birds); however, this provision would not apply to non-BLM-managed lands. Implementing BMPs, such as Potential BLM Mitigation Measure 2 (see Section 3.3.4 of Appendix N), to discourage nesting in areas where project activities would occur, regardless of land status, and mitigating human disturbance to colonies could minimize the take of birds, eggs, and nesting colonies (Ontario Ministry of Natural Resources and Forestry 2017).

Indirect effects of road construction on bird habitat would occur during all phases of road construction and operation at varying distances due to gravel spray, fugitive dust, dust abatement chemicals, snow accumulation, thermokarsting, snow drifting, alteration of water drainage and snowmelt patterns, and spread of exotic and invasive plant and animal species. Ice roads and pads can interfere with patterns and natural drainage of spring runoff. Road maintenance is likely to affect some waterbodies that are sources for water withdrawal for dust abatement and other activities, and this could affect shoreline habitat for waterfowl and shorebirds. These indirect effects would occur during all construction phases, during road operation, and during road closure and reclamation. As described in Section 3.3.1, Vegetation and Wetlands, fugitive dust could be deposited within 328 feet (100 meters) of the gravel road (Walker and Everett 1987) or beyond (Myers-Smith 2006; McGanahan et al. 2017). Fugitive dust deposition could also increase thermokarst and soil pH and reduce the photosynthetic capabilities of plants in areas adjacent to roads (Auerbach et al.1997). Indirect effects could reduce the availability of food sources, the productivity of vegetation, and the quality of potential nesting habitat, particularly for ground-nesting birds such as most waterfowl and shorebirds.

Invasive plants (see Section 3.3.1, Vegetation and Wetlands) and insects are likely to spread along the road corridor and may alter ecosystem dynamics (Handel et al. 2021 and references therein). Invasive insect species such as sawflies and aphids have become widespread in BCR4 and can cause severe tree defoliation during outbreaks, which may then affect densities of forest-nesting birds (Matsuoka et al. 2001, as cited in Handel et al. 2021). Proposed BLM mitigation measures (see Appendix N, Section 3.3.1.3, Non-native Invasive Species) would require AIDEA to prepare an Invasive Species Prevention and Management Plan to prevent the spread of non-native and invasive plants and animals, require decontamination of equipment and vehicles, reduce the spread of invasives by commencing authorized activities from areas of least infestation toward infested areas, and require mineral materials to be certified as weed-free.

Disturbance and Displacement

Birds may be disturbed or displaced during construction due to vehicle and aircraft traffic, blasting for gravel mining, pile installation, mineral exploration and mine development, and other industrial construction activities described in Chapter 2, Alternatives. The greatest impacts to birds would occur during the breeding season, which generally occurs from May through September, although some raptors, geese, and swans may nest earlier. Overwintering and resident species, such as ptarmigan, grouse, ravens, and other species also may be disturbed during winter construction.

Under all alternatives, mineral exploration via aircraft is expected to continue, resulting in widespread long-term and short-term potential impacts of aircraft across the project area. Waterfowl are particularly sensitive to low-flying aircraft and respond during breeding, molting, migration, and wintering (Ward et al. 2000). Response to aircraft depends on both species and life stage. Short-term aircraft disturbance studies from Alaska's North Slope found that mean waterfowl flushing distances for various types of overflights ranged between 1.2 and 2.5 miles and durations averaged between 5 and 6 minutes, depending on overflight category, such as aircraft and altitude; frequent disturbance was found to drive geese away from feeding sites (Davis and Wisely 1974; Salter and Davis 1974). In an experimental study conducted during the fall at Izembek NWR, researchers flew over groups of fall-staging brant and Canada geese using both fixed-wing aircraft and helicopters (Ward et al. 2000). They found that lateral distance between the aircraft and the flock was the most important factor influencing goose behavioral responses of both species; responses typically decreased as the lateral distance of the aircraft increased. Geese response to overflights was greater at high noise levels; large rotary aircraft (e.g., Bell 205 helicopter) elicited the most intense disturbance reactions.

Disturbance of staging (pre-migrating) geese could result in decreased feeding time, increased energy expenditure, and displacement from preferred high-quality feeding areas. These all could affect their ability to accumulate adequate energy reserves to fuel their fall migration (Davis and Wiseley 1974) or could displace them to staging habitats elsewhere. Ward et al. (2000) modeled goose energetics in response to aircraft disturbance and estimated that 10 aircraft overflights could result in a 4 percent reduction in expected body mass of brant. High body mass loss was expected if brant were exposed to 45 daily aircraft overflights (Ward et al. 2000). Predictions of body mass depended heavily on other factors such as feeding rate, caloric value of eelgrass (the primary food source for staging geese at Izembek NWR), and the rate at which food were assimilated by geese.

Aircraft overflights can temporarily reduce the numbers of waterfowl on lakes (Schweinsburg 1974), but nesting birds show variable reactions. For example, brant were observed to flush from nests in response to some aircraft overflights, while nesting common eiders were rarely observed to show any visible reaction in response to such activities (Gollop et al. 1974a). In industrial areas at Prudhoe Bay where some habituation to disturbance is likely, routine oil field activities, such as road traffic, noise, and aircraft

flying at the prescribed minimum altitude of 500 feet, typically did not cause nesting geese to react (Murphy and Anderson 1993).

The effects of aircraft disturbance on other species, groups such as raptors and passerines, has also been studied. In a study of the effects of low-level military overflights on the breeding behavior of peregrine falcons, Murphy et al. (2000) found that nest attendance and time-activity budgets of nesting birds differed significantly between reference nests (receiving less than 7 noise events per season) and those that were frequently overflown. In general, failed nests were exposed to greater aircraft disturbance than were successful nests, although statistical comparisons of exposure levels between these 2 groups were not significant. Studies of aircraft noise on the reproductive success of passerines have shown that it has the potential to mask their calls and songs, affecting reproduction and predator avoidance (Hunsacker 2000).

Disturbance can increase concealment behaviors; decrease nest attendance (Johnson et al. 2003, Parrett et al. 2023); or interfere with resting, feeding, and brood-rearing activities (Murphy and Anderson 1993). It can also increase energetic costs or lead to displacement of breeding birds, which may increase nest and brood predation, thereby reducing reproductive success (Johnson et al. 2008; Stien et al. 2016). Noise and visual disturbances are often coincidental, as they are with road and air traffic. It is rarely possible to separate and identify which causes responses in field studies. The distance at which disturbance results in behavioral changes in birds varies by species, life stage, the source of the disturbance, and each individual's tolerance or habituation to disturbance sources (Bayne et al. 2008; Livezey et al. 2016).

Noise and light pollution may extend large distances from the gravel footprint, depending on vegetation type, topography, ambient sound levels, and various other factors (Bayne et al. 2008; see Section 3.2.6, Acoustical Environment (Noise), and Appendix D, Attachment A, for more information on noise). Noise pollution could result in an increase in energy expenditure due to higher stress levels and an increase in startle and flight responses. Noise could also inhibit predator detection and intraspecific communication (Barber et al. 2010; Brown et al. 2012) while light pollution can alter singing, nesting, and mating patterns (Da Silva et al. 2015). These behavioral changes could result in reduced foraging rates and decreased mating success.

Disturbance and displacement would occur during each of the 3 construction phases and during road operation, maintenance, closure, and reclamation and would likely be greatest during Phase 1 construction when clearing and ground-disturbing activities would occur in previously undisturbed habitat. Once constructed, the Phase 1 pioneer road would not be used in spring/early summer (May through July), resulting in less disturbance to birds than Phases 2 and 3, which operate year-round. Potential BLM mitigation measures (see Appendix N, Section 3.3.4, Birds) that discourage intentional harassment of birds would only slightly lessen the overall disturbance impacts that largely result from the use of construction equipment and vehicle use, and these mitigation measures would only be required on BLM-managed lands.

Injury and Mortality

During construction, birds could be incidentally injured or killed during the initial removal of vegetation, particularly if it is conducted during the breeding season. Vegetation removal for construction would result in habitat loss and create "open areas that may fragment populations of forest-dwelling species," and mowing practices could "directly kill eggs, fledglings and adults attending nests" (Kociolek et al. 2015), which could reduce productivity and abundance at the local population level for some species. The majority of surface disturbance is expected to occur during Phase 1 construction. During construction of subsequent phases, vegetation removal would be limited to that along the edge of the road. Generally, this vegetation is of lesser quality and less likely to contain nesting birds.

The impacts of vegetation removal on birds in the project area may be partially offset by protections provided to all migratory birds under the MBTA and to special status species by the BLM special status species policy (BLM 2008b) and Alaska statewide land health standards (BLM 2004b). Both BLM policies include mitigation measures for activities that may result in population declines. Under Potential BLM Mitigation Measure 1 (see Appendix N, Section 3.3.4), AIDEA would ensure that vegetation clearing on BLM-managed land was scheduled outside of the nesting season and would require biological surveys prior to vegetation clearing during the nesting season. The USFWS recommends avoiding vegetation clearing and avoiding ground-disturbing activities between May 1 and July 15 in forested/woodland and shrub/open habitats—up to 2 months earlier for raptors and 2 weeks earlier for waterfowl (USFWS 2023). For eagles, this period is between March 1 and August 31.

Birds may collide with vehicles, including construction equipment, throughout all phases of road construction, but collision rates could increase during later project phases. Studies of vehicle-related bird mortality in the North America have estimated collision rates of less than 1 to 223 birds per mile of road, depending on traffic volume, adjacent habitat types, bird species group studied, and other factors (Erickson et al. 2005). Phase 3 has the potential to cause higher rates of vehicular bird strikes, as the 2-lane road is being designed for travel at speeds up to 50 miles per hour.

Collision hazards during the operations phase of the project include vehicles, bridges, communication towers, and other structures (Erickson et al. 2005; Loss et al. 2015). The potential for collisions with vehicles is directly related to traffic volume and travel speed (Loss et al. 2014, 2015), which are both expected to increase over time and would be greatest during Phase 3. According to the environmental report for the Trans-Alaska pipeline renewal (TAPS Owners 2001), vehicle collision along the Dalton Highway was the greatest source of avian mortality associated with the pipeline. Ptarmigan, grouse, and passerines were the primary species groups killed by vehicle collisions, although small numbers of raptors have also been killed in vehicular collisions along the Dalton Highway. Collisions mainly occurred in the northern sections of the Dalton Highway where birds were attracted to roadside areas of early green-up caused by dust shadows. Raptor species that hunt along the road and dust shadow, including rough-legged hawk, northern harrier, and short-eared owl, would be the most susceptible to vehicle collisions (TAPS Owners 2001). Collisions with stationary objects such as bridges, communication towers, buildings, and transmission lines are most likely during periods of low visibility (MacKinnon and Kennedy 2011). Both the presence of guy wires on towers and characteristics of warning lights affect the potential for collisions with these structures (Erickson et al. 2005; Loss et al. 2015). Carrion would attract some bird species and result in mortality while they were scavenging on the road (Kociolek et al. 2015).

Collision potential could be greater at bridges than at other points along the Ambler Road due to concentrated use by many bird species. Waterbirds use rivers and streams as movement corridors, particularly during migration, and many raptor species present in the project area nest in these riparian habitats. Cliff swallows, which breed in the project area, often construct their mud nests on artificial structures such as bridges (Brown et al. 2020). While the species is quite tolerant of human activity, the presence of breeding colonies on bridges has the potential to interfere with road construction and bridge maintenance during summer months because the species and its nests are protected under the MBTA. Use of barriers and the broadcasting of alarm calls can prevent cliff swallows from constructing nests on bridges; however, success of these deterrents is mixed (Cliff Swallow Project 2023).

Populations of avian predators (foxes, bears, ermine, raptors, gulls, jaegers, ravens) have the potential to increase with the development of the proposed project partly because of increased availability of artificial nesting structures and perching sites (e.g., bridges, culverts, communication towers, buildings), human food sources from dumpsters, and hand-outs (NRC 2003). Ground-nesting birds, such as most shorebirds and waterbirds, are at particular risk for nest depredation. Researchers working in Prudhoe Bay

documented an increase in the numbers of 2 avian egg predator species (glaucous gull and common ravens on shorebird research plots during 2003–2019, and other studies have found a similar long-term increase in glaucous gull numbers (McGuire et al. 2023). Potential BLM mitigation measures (see Appendix N, Section 3.3.4, Birds) intended to control trash may minimize this potential issue on BLM-managed lands.

Alternative A Impacts

Avian habitat lost or altered due to Alternative A would consist primarily of upland low and tall shrub (7,466.5 acres, including the dust shadow; Appendix E, Table 8) and upland mesic spruce forest (6,308.5 acres). Alternative A would result in fewer acres of alpine and arctic habitat loss than Alternatives B and C (see Appendix E, Tables 8 through 10). As with other alternatives, the proportion of wetlands impacted development is high; 60.5 percent (10,837.1 acres) of the impacted acreage is classified as wetlands or waterbodies, most of which is palustrine scrub-shrub (see Appendix E, Table 11). Avian habitat associations lack the refinement, and vegetation mapping lacks the detail necessary to accurately predict and quantify impacts at the species level. Overall, Alternative A would result in less habitat reduction and alteration than the other action alternatives.

Alternative B Impacts

Habitat loss and alteration under Alternative B would be nearly 11 percent (1,938.4 acres) greater than under Alternative A (see Appendix E, Tables 8 and 9). The proportions of affected vegetation types are similar to those under Alternative A, with upland low and tall shrub and upland mesic spruce forest comprising the majority of affected habitat types. A high proportion of the affected acreage (12,269.9 acres, or 61.9 percent) is classified as wetlands or waterbodies and primarily consists of palustrine scrub-shrub (see Appendix E, Table 12). More acreage of palustrine forest would be altered or lost under Alternative B than any other alternative (1,094 acres more than Alternative A and 1,734 acres more than Alternative C), which could have a greater impact on forest-nesting species, including raptors and songbirds. Due to the poor granularity of available vegetation mapping and lack of refined species habitat associations, it is not possible to quantify differences between Alternatives A and B in regard to potential impacts on birds.

Alternative C Impacts

Impacts to birds are anticipated to be greatest under Alternative C. The total acreage of impacted habitat (26,092.3 acres) is highest under Alternative C (6,258 acres greater than Alternative B and 8,197 acres greater than Alternative A) (see Appendix E, Tables 8 through 10). As with other action alternatives, avian habitat affected by Alternative C would primarily consist of mesic spruce forests and upland forests, and the affected acreages of these types are similar to those in Alternatives A and B. However, Alternative C crosses more alpine and arctic tussock tundra (2,045.2 acres versus 495.0 acres under Alternative A and 529.1 acres under Alternative B) and riparian forest and shrub (3,247.8 acres versus 382.9 acres under Alternative A and 490.4 acres under Alternative B) than the other action alternatives (see Appendix E, Tables 8 through 10), which would result in greater impact to bird species that depend on these habitats. Alternative C would also impact the highest acreage and proportion of wetlands and waterbodies (16,289.7 acres, or 62.4 percent) (see Appendix E, Table 13). Alternative C crosses through an area identified in the Central Yukon REA (Trammell et al. 2016) as having high waterfowl species richness. In addition, Alternative C is substantially longer and would result in more avian habitat reduction than the other alternatives. Due to its length, Alternative C would require longer construction periods, more air traffic, and more construction and operation support facilities, resulting in higher levels of disturbance and displacement of birds using the area.

Combined Phasing Option

Combining Phases 1 and 2 of road construction into a single year-round 1-lane road project has the potential to reduce long-term disturbance and displacement of birds because it shortens construction time by 1 to 2 years and requires a single construction period. The road footprint of the combined phasing footprint would be 4 feet wider than the Phase 1 footprint; therefore, a greater number of acres would initially be cleared under this option. However, the total acreage lost and altered under the combined phase option would be equal to that under phased alternatives. A thicker road embankment would mitigate impacts to permafrost, water quality, and aquatic habitats which in turn would reduce indirect impacts of the road on bird species and habitat quality.

Mining, Access, and Other Indirect and Cumulative Impacts

RFAs associated with AIDEA's proposed action that would impact birds include the advanced mining development scenario, the indirect road access scenario, and other actions located throughout the vicinity of the project area (see Appendix H). The indirect and cumulative impacts on birds from the combined development of these actions would be additive to and synergistic with the action alternatives. Development of the advanced mining scenario and community road access would have the greatest impacts on birds and their habitat. Additionally, most of the RFAs would occur on non-federal lands, where BLM special status species policy (BLM 2008b) and Alaska statewide land health standards (BLM 2004) would not apply.

Construction of the Ambler Road project would result in construction of mines and increased mineral exploration in the Ambler Mining District. Four projects along the eastern road route are actively being explored, and a permit for exploration of the Shungnak Mining District has been submitted. Additional exploration between the Dalton Highway and GAAR is ongoing, and additional mining exploration is highly likely. Direct and indirect habitat loss and alteration due to the increased exploration and development of the District and community access roads would result in habitat loss, alteration, and fragmentation of avian breeding, nesting, foraging, staging, and stopover habitat. Habitat impacts due to the mines is anticipated to be thousands of acres, not including access roads (see Appendix H, Table 2-10). Secondary access roads connecting communities could range from a few miles to over 100 miles in length (see Appendix H, Table 2-11). The mines, mining roads, and secondary access roads would increase habitat fragmentation exponentially. The fragmentation of habitat would further create anisotropic barriers to movement (Belisle and St. Clair 2001) and remove usable habitat for birds, which could force range shifts, increase competition for resources, and increase predation rates (Angelstam 1986, NCASI 2008). Fragmentation can also create habitat for species that prefer forest edges or generalist species that use anthropogenic infrastructure. Increased road use by miners accessing new and existing claims is expected.

Disturbance and displacement impacts on birds due to RFAs would be similar in nature to those described in Impacts Common to All Action Alternatives. Impacts to birds from any of the action alternatives in combination with the any of the cumulative actions that include construction, mining activities (including machinery use and blasting), road use, and air traffic would be both additive and synergistic to any of the action alternatives. Arctic oil development, expansion of the Red Dog Mine, and improvements to the Dalton Highway would result in similar impacts as the action alternatives, resulting in additive cumulative and synergistic impacts to avian species that use habitat in the project area, particularly migratory species. In addition, the introduction of contaminants and hazardous substances to the soil and waterbodies, including tailings ponds, would increase avian mortality, particularly among waterbirds, shorebirds, and larids. Vegetation removal activities would result in injury and mortality of birds and destruction of nests.

Construction of the Ambler Road project is likely to spur additional non-mining developments, such as the placement of a fiber-optic line and communication towers to serve both area residents and mining operations. Placement of a buried line could result in the loss and alteration of additional bird habitat, and construction of additional towers could increase avian collisions and provide nesting structures for avian predators such as hawks and ravens.

Although the road would not be open to the general public by design, public use and trespass are expected to occur (see Appendix H, Sections 2.2.2, Public and Non-Industrial Access, and 2.2.3, Trespass Scenario, for details on potential changes in road access and use). If public access of the Ambler Road is authorized, commercial use could result in increased trips by larger vehicles to service communities along the road. Commercial road access is likely to increase the alteration of habitat through the increase in road dust generation, and gravel spray as well as through possible spills contamination. Continued road maintenance, including grading, plowing, and dust abatement would be necessary (see Impacts Common to All Alternatives for a description of road maintenance impacts). Increased traffic is also likely to result in increased avian collisions throughout the year, with the highest increase likely during the breeding season. Non-commercial public access to the Ambler Road (authorized and unauthorized) is likely to result in additional habitat, noise, visual, and other disturbances from recreationalists (boaters, hikers, ORV operation) and hunters. Use of the road by both subsistence and non-subsistence hunters would increase disturbance and mortality of gamebird species, primarily waterbirds and grouse/ptarmigan. Localized habitat alteration through the use ORVs for both hunting and recreation is also likely and may result in the degradation of sensitive habitats such as upland tundra and wetlands. The accelerated spread of invasive species through recreational and hunting use of the road corridor to access waterways and other areas of interest is also likely and would negatively impact avian habitats.

Climate change is expected to continue to affect bird populations across their ranges but would be most pronounced in the Arctic. The changing climate has varied impacts on different bird species, and impacts would depend on how quickly and dramatically the vegetation and hydrology change. Within the project area, the effects of climate change are anticipated to include higher average temperatures, increased intensity of weather events, changes in the wildfire regime, shifts in vegetation distribution, increase in insect abundance, increase in pathogens, a change in the abundance of predators, shifts in trophic cascades, and changes in ecosystem function and ecosystem services (Marcot et al. 2015; Mallory and Boyce 2018). The effects of these changes on birds would generally be negative, but would be variable depending on individual species' life history. The impacts of climate change on birds would also interact synergistically with the proposed project. The cumulative impacts on birds would be similar regardless of the action alternative selected. For birds, climate change could affect phenology, habitat and forage availability, and alteration of ranges. Some bird species could benefit from longer breeding seasons and expansion of shrub and tree habitats, while others could lose habitat, food, or prey and could experience seasonal mismatches in breeding and plant/insect phenology (seasonal timing of events) (i.e., trophic mismatches; see Doiron et al. 2015). It is possible that birds are unable to adapt to trophic mismatch (Dawson 2008; Kumar et al. 2010). The historically dominant landbird and waterbird species may be displaced northward or into shrinking remnant habitats. Marcot et al. (2015) projected that about 52 percent of bird species would experience an increase in medium- and high-use habitats, while 45 percent would experience a decrease. Kubelka et al. (2018) suggested predation is increasing in the Arctic and is linked to climate-induced shifts in predator-prey relationships, which could adversely affect both numbers and productivity of nesting birds. However, Bulla et al. (2021) reanalyzed the same data set and did not find that predation rates in the Arctic were increasing any faster than elsewhere.

Climate change combined with other cumulative actions may alter habitat, and increase the prevalence and intensity of wildfires and extreme weather events (Hinzman et al. 2005). Increases in shrubs and trees have been documented (Sturm et al. 2001; Tape et al. 2006) and are expected to continue with increasing

summer temperatures. If available wet sedge and graminoid meadows are reduced by invading shrubs and decreasing moisture, it may result in shifts in the breeding bird community. Shrub- and tree-nesting birds (passerines such as redpolls, sparrows, and thrushes) may become more numerous, and tundra nesting birds (longspurs, savannah sparrows, shorebirds, and geese) may decline (Marcot et al. 2015). With a longer breeding season and increases in shrub and tree cover, breeding species more typical of boreal forest areas to the south may extend their ranges northward and possibly compete with current tundra breeders for resources. Of particular concern is the decline in the habitat of small mammals that form the prey base for raptors. Thermokarsting and permafrost thaw may also mobilize contaminants, including heavy metals, such as mercury, into surface waters from the thawed sediments. In northwestern Alaska, recent observations indicate that waters that drain permafrost landscapes are transporting high concentrations of iron from thawing soils to streams, which are exhibiting higher iron concentrations, less dissolved oxygen, and more acidic water than nearby clear-running streams (USGS 2022). Such contaminants could pose health risks to birds, particularly to species that feed on aquatic invertebrates and fish.

Habitat loss and alteration due to the reasonably foreseeable development of the District could more than equal that from the road and exponentially increase fragmentation of avian habitat. Disturbance and displacement from mining activity would be in addition to disturbance due to road construction and use. Warming Arctic conditions combined with other cumulative actions and may increase wildfires, change the abundance and distribution of forage and nesting habitat, or increase the prevalence and intensity of weather events. The accumulation of impacts on birds would be similar regardless of the action alternative selected. As described above, RFAs not associated with AIDEA's proposal would affect birds and bird habitat in the analysis area. The impacts of climate change on birds, described above, would occur equally under the action alternatives and No Action Alternative.

3.3.4 Mammals*

Affected Environment

As many as 38 mammal species may occur in the project area (see Appendix E, Table 18). The ADF&G, NPS, and BLM regularly monitor large terrestrial mammals such as caribou and moose (Dau 2015; Jandt 1998; Joly and Cameron 2017). Species occurrence and distribution information for other mammals is based on Cook and MacDonald (2006) and MacDonald and Cook (2009), as well as interactive range maps from the ACCS Wildlife Data Portal (ACCS 2019b) and the NPS Species Checklist (NPS 2019b) and are incorporated by reference. Mammalian species presence varies across the project area, depending on habitat type and prey distribution. Most of the alternatives are in low and tall shrub habitats or mesic spruce forests of the Kobuk Valley and Ray Mountains ecoregions (see Section 3.3.1, Vegetation and Wetlands).

Caribou

The project alternatives occur within the ranges of 2 caribou herds: the Western Arctic Herd (WAH) and the Ray Mountains Herd (RMH) (only Alternative C). Increased vehicle traffic on the Dalton Highway (under Alternatives A and B) may also affect the Hodzana Hills Herd (HHH). Other nearby herds include the Teshekpuk, Central Arctic, and Porcupine herds north and northeast of the project area (Dau 2015; Prichard et al. 2020a) and the Wolf Mountain Herd (WMH) south of Alternative C (see Volume 4, Map 3-20). Because the WMH does not occur in the project area, it are not anticipated to be affected and is not discussed further. Individuals from the CAH and Teshekpuk Herd may occasionally enter the project area during winter. During the winter of 2021–2022, a large portion of the Central Arctic Herd (CAH) wintered on or near the range of the HHH (Welch et al. 2022), and animals of the Porcupine Herd have also wintered in this area in recent years. Caribou of the CAH tend to winter farther south in years of high snow depth on the North Slope (Pedersen et al. 2021). Low numbers of collared Teshekpuk Herd caribou

have overwintered on the Seward Peninsula, near Kobuk, and near Noatak (Fullman et al. 2021a; Parrett 2019) in some years. In addition, animals from the Teshekpuk Herd, periodically join the WAH (Prichard et al. 2020b) and the portion of the Teshekpuk Herd wintering in the central Brooks Range could use the project area in the future if the herd expands and shifts its distribution. Overall, use of the project area by Teshekpuk Herd and CAH caribou is currently low, so these herds are not discussed further.

The majority of caribou in the project area are members of the WAH (Prichard et al. 2020b), which ranges over approximately 157,000 square miles (363,000 square kilometers) of northwestern Alaska (Dau 2015; see Volume 4, Map 3-20). Human development in the WAH range is currently limited to approximately 40 rural villages and the Red Dog lead and zinc mine, which includes a 52-mile private road and port site (WAH WG 2011).

The RMH and HHH are small, non-migratory caribou herds that inhabit the area north of the Yukon River community of Tanana, within the Ray Mountains and Hodzana Hills, respectively (see Volume 4, Map 3-20; Horne et al. 2014; Pamperin 2015). No notable human development exists within the RMH range. The Dalton Highway is the primary, notable human footprint within the HHH range (Horne et al. 2014). The RMH and HHH have been a lower priority for research by ADF&G and other agencies due to their small size, isolation, and absence of substantial hunting pressure; however, because of the limited information available, global positioning system (GPS) collars were deployed on these herds starting in 2020. As a result, little is known about the seasonal distribution, abundance, habitat use, diet, and other life history factors for the RMH and HHH. The lack of available, specific data for these herds means the impact evaluations pertaining to these 2 herds require a greater dependence on what is known about better studied caribou herds. The BLM considered this lack of data and determined there was sufficient information based on general knowledge of caribou and based on what is known specific to the RMH and HHH to make a reasoned choice among alternatives and to disclose relevant impacts, but additional GPS collars were deployed on these herds in 2020, providing new information on seasonal distribution for recent years.

Major mortality events have occurred during winter throughout the range of the WAH. Winter rain events cause ice and strong winter storms that create wind and deep snow, limiting access to critical winter forage and contributing to episodic population declines (Joly et al. 2010; Joly and Klein 2011). Cows exhibit poor physiological conditioning, lower calf birth weights, reduced calf survival, slower growth of surviving calves, poor body condition of calves, reduced pregnancy rates, and delayed birthing during springs that follow winters with deep snow (Adams et al. 2006; Joly and Klein 2011). Unusually strong winter storms near Cape Thompson during 1994–1995 and 1999–2000 brought cold temperatures, strong winds, ice, and dense snow cover. ADF&G research links those conditions to poor body condition in caribou, suggesting that starvation exacerbated by storms contributed to large die-offs during those years (Dau 2005). As caribou densities hit their peak, competition for food resources could also contribute to localized mortality events in winter range areas, as have occurred in other Arctic caribou populations (Ferguson and Messier 2000; Jandt et al. 2003; Joly et al. 2007). However, in the WAH, large mortality events that occurred episodically during difficult winters with ground conditions that could prevent caribou from accessing food resources appeared to be a larger factor than overgrazing of the winter ranged during recent decades (Dau n.d.a).

Caribou are a preferred prey for wolves and can comprise up to 60 percent of the wolf diet, and wolves cause up to 7 percent of the WAH mortality each year (Ballard et al. 1997). Wolves preferentially prey on caribou in Central Alaska, even when moose and sheep are abundant (Dale et al. 1994). Caribou and other ungulates comprise a larger proportion of the grizzly bear diet in Interior Alaska, as compared to coastal bears that consume a diet of mostly salmon (Mowat and Heard 2006). Other carnivores that may prey on caribou include wolverines, coyotes, and golden eagles, but they generally target the young, very old, or

debilitated in a herd (Joly and Klein 2011), although wolves and brown bears can and do take caribou of any age or condition throughout the year given the right environmental conditions or circumstances.

Caribou are an important subsistence and cultural resource for Alaska Natives living within the communities located throughout the WAH range (see Appendix F, Table 23). Harvest of WAH caribou occurs primarily through local subsistence or non-local sport hunting in game management units (GMUs) 21D, 22A–E, 23, 24, and 26A. Total harvest of subsistence and sport-hunted WAH caribou in 2014 was approximately 6 percent of the population. ADF&G indicates this includes a small number of Teshekpuk Herd caribou since they and WAH can co-occur during their fall migration (Dau 2015). Local subsistence hunters generally travel by boat on rivers in summer or snow machine in winter, while non-local sport hunters primarily travel by aircraft. Sport hunting of the WAH has occurred for many years, but appears to have increased rapidly since 2000 then stabilized or declined due to regulatory changes, herd declines, and national economic downturn (Fullman et al. 2017). Conflict between local and non-local hunters has arisen due to perceived negative effects of aircraft on caribou behavior and local hunter success. Studies (e.g., Fullman et al. 2017) have not shown that WAH caribou alter their fall migration due to non-local hunting activity, although fine-scale or short-term responses may be altering availability of caribou to local hunters. See Section 3.4.7, Subsistence Uses and Resources, for further information about subsistence hunting of caribou.

Lichens are the primary forage for WAH caribou in late fall and throughout winter, comprising over 70 percent of their diet (Joly and Cameron 2018a). Lichen are a major source of carbohydrates and help caribou survive winter until emergent forage appears in spring (Joly et al. 2012). Studies suggest that caribou with access to lichens have better body condition, may experience less competition for food, and have a better chance of surviving winter (Joly and Cameron 2015; Joly et al. 2015). The RMH and HHH, like other non-migratory, low-density caribou herds, persist with limited lichen consumption (Adamczewski et al. 1988; Joly and Cameron 2018a; Thomas and Edmonds 1983). The RMH appears to select deciduous dwarf shrublands for foraging (Horne et al. 2014).

Fires and overgrazing could result in long-lasting impacts on WAH caribou survival and fitness. Lichens are particularly prone to the effects of fire due to their structure, moisture content, and position atop the tundra canopy. Fires and overgrazing result in a shift from lichen to a cover of fast-growing grasses and herbs that could persist for decades (Jandt et al. 2003, 2008; Joly et al. 2009; Palm et al. 2022). Wilson et al. (2014) found that recent fires have removed large portions of high-quality habitat in the eastern half of Alternatives A and B, and large portions of Alternative C intersect past burn areas (Boggs et al. 2012). In northwestern Alaska, dwarf and tall shrub cover has increased substantially over the last quarter century (Joly et al. 2009). Low abundance of quality winter forage could cause caribou to migrate farther in search of suitable habitat, which increases energy expenditure and exposes them to increased predation risk (Joly et al. 2010; Dau 2015).

Herd Size and Trends. Caribou herd populations experience cyclical growth and decline (see Appendix A, Figure 3-1). ADF&G studies indicate the WAH experienced a steep decline from 1970 to 1976, when the population dropped from 242,000 to 75,000. From 1976 to 1990, the herd increased 13 percent annually on average (Dau 2015). The ADF&G has conducted aerial photo censuses of the WAH since 1986 and has tracked collared individuals since 1979. The population peaked at more than 490,000 caribou in 2003 (Dau 2015), raising concerns about potential overgrazing (Joly 2011). The WAH then experienced another decline. Reasons for the decline are uncertain, but could be due to declines in lichen cover in their winter range or severe winter weather events. In 2007, studies estimated the population at 377,000 individuals, and it continued to decline at approximately 4 to 6 percent per year, until 2011, when it reached 325,000 animals (Joly 2011). Between 2011 and 2013, the population dropped to 235,000, which is an average annual decline of 15 percent. According to ADF&G studies, this steep decline was

due to very high mortality in winter 2011–2012 and low recruitment during 2012 and 2013 (Dau 2015). The population continued to decline through 2016, when surveys estimated it at 201,000. The estimated population increased to 259,000 caribou in 2017, but subsequently declined to 181,000 in 2021 (ADF&G 2022) and was estimated to be 164,000 caribou in the most recent photographic census conducted in 2022 (Rosen 2022).

In 1983, the ADF&G surveyed the RMH for the first time and counted 400 caribou. Between 1994 and 2012, the long-term population size was between 656 and 1,564 animals (Horne et al. 2014). Unlike the larger herds in Alaska, the RMH and HHH populations remain relatively consistent and do not experience cyclic fluctuations. A July 2018 survey, the most recent conducted, counted 812 caribou (Longson 2019). Radio telemetry data from 2005 to 2009 estimated the HHH at 1,000 to 1,500 animals (Horne et al. 2014; Longson 2020; Pamperin 2015). The RMH and HHH appear to be stable and comparable in size (see Appendix A, Figure 3-2). Hunter and subsistence harvest is low for both herds due to limited access and a short season (Longson 2020; Pamperin 2015). Predation appears to be the primary factor limiting herd growth, although body size appears to have declined over time (Pamperin 2015).

Traditional Knowledge. Local residents of communities within and near the project area contribute invaluable observational information on long-term caribou distribution trends. Particularly valuable are observations and accounts of caribou from before regular scientific monitoring began in the 1970s. Local residents' observations are also extremely valuable to managers regarding factors that scientists do not monitor (e.g. caribou body condition, snow characteristics, and many other factors). Comments from the public and cooperating agencies (i.e., Northwest Arctic Borough [NAB]) during scoping and from the public during the Draft EIS comment period illuminated the wealth of knowledge available from local residents and are summarized here. Most comments consistently described a decline in caribou availability over the last 50 years. Residents of Bettles/Evansville, Hughes, Tanana, Alatna, and Allakaket describe a steep decline in local availability of caribou immediately following construction of the Dalton Highway and TAPS in the mid-1970s; referencing a belief that the introduction of the Dalton Highway resulted in a diversion from their previous migration route. Residents of Huslia recounted high caribou availability in that area 30 years ago, but very few today. Today, hunters must travel 60 miles from Huslia to find caribou to harvest. Changes in migration pathways have also been observed over the decades, particularly in the vicinity of Ambler and Bornite. At least 1 local resident reports a drastic change in caribou abundance near Bornite since mineral exploration began in the District. During Western Arctic Herd Working Group (WAH WG) meetings, Northwest Arctic Subsistence Regional Advisory Council (RAC) meetings, and scoping for this project, multiple commenters expressed concern with the changing distribution and declining herd size of the WAH, the potential effects of climate change on caribou, high densities of predators, the impact of non-local hunters, and potential impacts from development on caribou and subsistence harvest (see also Section 3.4.7, Subsistence Uses and Resources). There was concern for rain on snow events impacting caribou and roads altering migration routes or timing of migration.

Life History and Seasonal Distribution. Caribou occupy different types of habitat throughout their range, depending on the season. They use their ability to efficiently travel long distances to access areas with abundant forage plants, minimize predation, and escape insect harassment. Caribou make some of the longest terrestrial migrations on the planet (Joly et al. 2018), and the WAH is the most wide-ranging caribou herd in Alaska. According to ADF&G studies, the WAH has exhibited the same general movement patterns for the last 50 years (Dau 2015) and generally show high fidelity to their calving grounds (Cameron et al. 2020; Joly et al. 2021). Recent studies have reported that fall migration of arctic caribou herds is influenced by temperature, snow timing, and depth (Cameron et al. 2021, Pedersen et al. 2022). However, their specific migratory routes and overwintering areas show greater annual and even decadal variation (see Volume 4, Maps 3-23 and 3-23b; Joly et al. 2021). Their total distribution extends

from the Chukchi Sea coast east to the Colville River, and from the Beaufort Sea coast south to the Seward Peninsula and Nulato Hills. This range encompasses most of the project area, which the WAH generally uses during migration and as winter range (see Volume 4, Map 3-21; Dau 2015). ADF&G indicated during Draft EIS comments that the WAH used the project area more extensively during the 1980s than the past 15 to 20 years; however, as mentioned above, shifts in range use can occur on decadal time scales (Dau 2015), and there has been increased use of northern wintering areas in the years since the Final EIS was published in 2020.

According to ADF&G studies, spring migration appears to coincide with average daily ambient temperatures above freezing (Dau 2015). Pregnant cows from the WAH begin their spring migration in early May, while bulls and non-maternal cows begin in mid-May (Dau 2015). Joly and Cameron (2017) found that the average date collared cows crossed the Kobuk River, which is approximately the same latitude as Alternatives A and B, is between late April and late May. The relatively large spread of dates may be due to the different timing of pregnant and non-maternal cows. The mapped migratory range (ADF&G 2017) generally overlaps with the western half of Alternatives A and B and the western one-third of Alternative C. The mapped peripheral range, which receives consistent but lower density use, generally covers the eastern half of Alternatives A and B, and the middle one-quarter of Alternative C (Mileposts [MP] 154 to 245; Volume 4, Map 3-21).

Pregnant cows head directly to the Utukok Hills, near the headwaters of the Colville River, to give birth in dense aggregations (see Volume 4, Map 3-20). Bulls and non-pregnant cows migrate to the Wulik Peaks and Lisburne Hills (Dau 2015; Joly and Cameron 2017; Romanoff 2018). Moist dwarf-shrub and moist low-shrub vegetation typically dominate calving grounds (Kelleyhouse 2001); however, caribou seem to prefer foraging on flower buds of tussock cottongrass (*Eriophorum vaginatum*; Kuropat 1984), which seems to be important to lactating cows (Eastland et al. 1989; Kelleyhouse 2001). After calves are born in early June, cows and calves travel to mix with the rest of the herd in the Lisburne Hills.

During summer, the WAH uses the western North Slope and central to western Brooks Range (Dau 2015; Joly and Cameron 2017). Mosquitoes and parasitic oestrid flies (warble fly and nose-bot fly) harass caribou during the early and middle summer months (Person et al. 2007; Dau 2015). In response to insect harassment, caribou form large aggregations and move rapidly towards the coast or other insect-free habitat such as river bars, dunes, drained-lake basins, and late snow-covered ridge tops (Murphy and Lawhead 2000). The WAH moves through the Brooks Range from west to east during this period. Avoidance of insects becomes the only factor that influences habitat selection during conditions conducive to insect activity (Dau 1986), and caribou typically feed less often and use areas with lower-quality forage (Johnson et al. 2021; Person et al. 2007). Caribou infested with oestrid fly larvae could suffer poor body condition and lower pregnancy rates (Cuyler et al. 2010; Hughes et al. 2009). Summer and insect relief season forage is predominantly sedge-grass meadow, dwarf shrub, and willows (Kuropat 1984). In late summer, as insect harassment subsides, the herd becomes more dispersed across the North Slope and Brooks Range, with some individuals traveling as far east as the Dalton Highway (Dau 2015; Joly and Cameron 2017; Joly et al. 2018).

Based on variability in both rate and direction of travel (Dau 2015), WAH caribou exhibit the maximum rate of travel while moving east through the DeLong Mountains and northern foothills during summer (cows: July 6–July 30; bulls: July 5–August 2). The direction of travel for both cows and bulls becomes more variable and, especially for bulls, much slower (Dau 2015), during "late summer" (cows: July 31–September 17; bulls: August 3–6 September). During the fall migration (18 September 18–November 7 for cows, September 7–November 4 for bulls), movements become more directionally oriented (south) and the rate of travel increases, especially for bulls (Dau 2015). During the mid-1980s through early 2000s, the vanguard of the fall WAH migration usually began crossing the Kobuk River around mid-

August and, for that portion of the herd that wintered south of the Kobuk, crossing was mostly completed between mid-October to early November (Dau 2023b). Since the early 2000s, the timing of WAH fall migrations has shifted later and become less temporally predictable. Since about 2010, on average, the WAH crosses the Kobuk River from early to mid-October (Joly and Cameron 2017). However, in some recent years, WAH caribou have continued to cross the Kobuk River well into late November. The project area is located within the eastern, approximately one-quarter section of known WAH caribou fall migration routes. Roughly 13 to 68 percent of the herd may pass through the project area during fall migration, between September and January, depending on the year (Joly et al. 2016; Joly and Cameron 2017). ADF&G studies indicate that the rut occurs during fall migration, although there is no specific location of the rut (Dau 2015).

The best information describing WAH distribution is available for the period after approximately 2002 when large numbers of high-resolution GPS collars became available, but previous wintering distributions are available (e.g., Volume 4, Map 3-23). Dau (2015) quantified the winter distribution of collared WAH females into 8 zones (Dau 2015:Tables 7, 8) to show annual and decadal patterns in WAH winter distribution during 1991–1992 through 2014–2015. The winter range of the WAH has continued to shift over time. In many recent years WAH caribou have wintered on the Seward Peninsula or in the upper Kobuk and Koyukuk river drainages (see Volume 4, Maps 3-21, 3-23, and 3-23b; Dau 2015). Collared caribou have wintered in the Buckland Valley, Selawik, and Nulato Hills (Jandt et al. 2003; Joly 2019; Joly et al. 2006). A small portion of the WAH occasionally winters on the North Slope near Point Lay, Atqasuk, or Umiat. Dau (2001) noted a shift in primary winter range from the Nulato Hills to the central Seward Peninsula during the mid-1990s likely due to overgrazing. In recent years, studies have observed a larger portion of the WAH wintering in the central and western parts of the Seward Peninsula (Romanoff 2018). The mapped WAH winter range (ADF&G 2017) overlaps with approximately 50 miles of Alternatives A (MPs 155 to 199) and B (MPs 172 to 216) on the western portion of those routes. The mapped winter range overlaps with approximately 77 miles of Alternative C (MPs 244 to 321; see Volume 4, Map 3-21). Wilson et al. (2014) found that 24 of 80 (30 percent) collared WAH caribou spent at least a portion of 1 winter (of 4 studied) within 15 miles of Alternatives A and B. More recently, a large proportion of the WAH has wintered in the Brooks Range (see Volume 4, Maps 3-23 and 3-23b).

Information on WAH winter distribution prior to the use of radio collars is limited to aerial surveys, anecdotal information, and traditional and local ecological knowledge. In addition, because the CAH and Teshekpuk Herd were not identified until the 1970s, the herd identity of observed groups of caribou is not always clear in observations recorded prior to the 1970s. The seasonal distribution of caribou herds often changes dramatically during herd population cycles with caribou inhabiting the core range during population lows (Skoog 1968). Hemming (1971:5) states, "During the most recent population low in the late 1800s, the few remaining animals occupied a small area of the North Slope including the present calving grounds." But following increases in the population size of the WAH, "By 1945 seasonal movements reached as far south as the Kobuk River" (Skoog 1968). Skoog (1968:309) states, "At first the center of abundance remained in the central Brooks Range, but during the late 1930s shifted farther to the west. The herd was increasing in size, and by the mid-1940's had started to winter in the Baird Mountains and along the Kobuk River drainages to the south." Skoog (1968:250) states "All records prior to 1945 showed that this herd wintered north of the Baird Mountains, and frequently on the arctic slopes and coastal plain. According to Harry Brown, a long-time resident on the Kobuk River (personal communication), caribou were not abundant along that river until the late-1940's. Since then, the herd has wintered each year mostly to the south, extending from the Waring Mountains, Baird Mountains, and lower Koyukuk River, eastward to the Wiseman area."

Satellite and GPS radio collar data for the WAH females first became available in 1987, although the number of collars has increased dramatically in recent years. Based on kernel density analysis of available

radio collar data for the WAH females, the annual high-density wintering area for the WAH from 1987 to 2022 was most often along the northern Seward Peninsula, but areas to the northeast of the Seward Peninsula also have had high-density wintering areas in multiple years (see Volume 4, Maps 3-23 and 3-23b). The annual wintering areas have been more northerly in recent years (see Volume 4, Map 3-23). This shift to a more northerly wintering range could have been a result of the decline in herd size, due to overgrazing of lichen on other wintering areas, a result of changing weather conditions during winter, or some combination of different factors.

On their winter range, cows from the WAH prefer northwest- and southwest-facing slopes and avoid flat terrain (Joly 2011; Wilson et al. 2014). Independent of lichen abundance, caribou preferred scrub, shrub, and sedge habitats over deciduous and mixed forests (Joly 2011). During winter, habitat selected by WAH caribou has up to 3 times the lichen abundance of unused habitat, and they select areas with fewer tall shrubs (Joly et al. 2007, 2010).

Unlike the WAH, the RMH and HHH do not undertake major migration and range within much smaller areas (Hollis 2007; Horne et al. 2014). Researchers once thought the 2 herds were a single herd, but telemetry data indicated little to no overlap between the herds, and studies identified the HHH as a distinct herd in 2007 (Hollis 2007). Separation of the RMH and HHH appears to be based on habitat selection and the presence of dwarf shrub forage, moderate slope, and lack of wetlands; the presence of a road did not seem to be a driver (Horne et al. 2014). While the availability of lichen as winter forage is important to the WAH, non-migratory herds such as the RMH and HHH may not depend as heavily on lichen abundance to support energetically expensive migrations (Joly and Cameron 2018), although studies on RMH and HHH diet have not been conducted to confirm this is the case. New GPS collars were deployed on females of the RMH and HHH in 2020 and similar to previous studies (Horne et al. 2014), these new data showed that there was a high level of overlap in seasonal ranges for each herd (see Map 3-23a).

The RMH range is roughly bounded on the south by the Yukon River, on the east by the Dalton Highway, and includes the entirety of the Ray Mountains. The northern extent of the range is located in the Kanuti Flats. RMH calving distribution is not well delineated. Studies have found that some caribou from the RMH calve on the southern slopes of the Ray Mountains in the upper Tozitna drainage, while other studies have suggested they calve on the northern slopes near Kilo Hot Springs (Jandt 1998). During summer, the RMH caribou have been found in the alpine zones of the Ray Mountains, such as Spooky Valley and Mount Henry Eakins. RMH caribou winter on the northern slopes of the Ray Mountains near the headwaters of the Kanuti-Kilolitna River (Hollis 2007; Jandt 1998; Pamperin 2015). Groups of 200 to 400 RMH caribou are typical during winter (Jandt 1998).

Caribou from the HHH are typically concentrated near the headwaters of the Hodzana, Dall, and Kanuti rivers on the east side of the Dalton Highway (Hollis 2007). Occasionally, HHH caribou occur west of the Dalton Highway. The Dalton Highway intersects the southwestern portion of their range during all seasons (Horne et al. 2014; Pamperin 2015).

Other Large Herbivores

Information on moose abundance and distribution in the project area is highly limited. Moose abundance and density in the project area are low. However, densities are comparable to those in other areas surveyed throughout northwestern Alaska and are likely regulated by wolves and bears (Lawler and Dau 2006; Reimer et al. 2016). According to NPS and ADF&G studies, population estimates do not appear to be meeting management objectives, natural mortality is high, and harvest is currently restricted (Joly et al. 2017; Stout 2018). Moose density within GAAR in 2015 was approximately 0.16 moose per square mile (0.06 moose per square kilometer), which suggests there has been little change in abundance from 2004 to

2015 (Sorum et al. 2015). This is consistent with density estimates in the upper Kobuk River drainage (Saito 2014). Population estimates between 2000 and 2013 in GMU 23 (which overlaps the western half of the project area) indicate moose densities ranged between 0.03 and 0.59 adult moose per square mile (Saito 2014). In GMU 24 (which overlaps the eastern portion of Alternatives A and B and the central portion of Alternative C), densities were approximately 0.48 moose per square mile (Longson 2019). The observed moose densities are low, particularly in the western and northern portions of the project area (Joly et al. 2016).

Moose in the project area select habitat with high canopy cover or 11- to 30-year-old burn areas (Maier et al. 2005). During winter, they select lower elevation areas close to rivers, except females with calves, which select more forested areas (Joly et al. 2016). Moose prefer tall shrub and riparian habitats in early successional stage areas with new or young vegetation (Joly et al. 2012). In the project area, winter concentration areas are present along major river drainages where riparian habitat is abundant (ADF&G 1973). Moose are also an important subsistence resource for residents within the communities of the Koyukuk and Yukon river drainages (Lawler and Dau 2006). It should be noted that impacts to moose were not identified as a significant issue based on scoping comments. Based on habitat information inferred from vegetation and other mapping, and consultation with cooperating agencies, the BLM determined there is sufficient information available to make a reasoned choice among alternatives.

Muskox and Dall sheep are present in northwestern Alaska, but it is unlikely either species would occur in the project area. The nearest distribution of muskoxen is located in the Cape Thompson area. A small group of muskoxen was observed within GAAR, likely comprised of individuals that have dispersed during range expansion (Lawler 2003). Individuals or small groups of muskoxen have been reported infrequently near Ambler and Kobuk, but these sightings are considered rare (Parrett 2019). Dall sheep occur within the steep mountain slopes, alpine ridges, and meadows of the Brooks Range (Reimer et al. 2016). Individuals occasionally seek shelter in lowland forests, particularly during heavy snow events or to transition between higher elevation areas but are unlikely to occur in the project area.

Large Carnivores

In this analysis, large carnivores include bears, foxes, wolves, and wolverines. Small carnivores (e.g., ermine, river otter) are discussed below under Small Mammals. Black bears and wolves are the most common large carnivores in the project area. Most species in this group are opportunistic mesocarnivores that inhabit large home ranges and a variety of habitats. For example, studies found that wolves in Alaska occupy ranges in excess of 1,100 square miles (3,000 square kilometers; Ballard et al. 1998). All the large carnivore species prey on or scavenge caribou and moose, but only wolves and grizzly (brown) bears regularly prey on adult ungulates. Caribou are preferred prey when in high abundance within their territories; however, wolves target moose during winter when caribou are absent (Ballard et al. 1997). In addition to moose and caribou, wolves also prey on voles, lemmings, ground squirrels, and snowshoe hares (Stephenson 1979). Grizzly bear density in the western Arctic is positively correlated with caribou density (Reynolds and Garner 1987), but abundance and distribution in the project area are largely unknown, particularly along Alternative C (Young 2015).[70]

Grizzly bear activity along Alternatives A and B peaks in August and September, when they are positively associated with salmon streams (Joly et al. 2016). Large aggregations of grizzly bears may occur along some salmon streams in the project area. Sorum et al. (2023) estimated that 24 individual

[70] Impacts to bears were not identified as a significant issue based on scoping comments. Based on habitat information inferred from vegetation and other mapping and consultation with cooperating agencies, The BLM determined there is sufficient information available to disclose impacts commensurate with the anticipated impacts and to make a reasoned choice among alternatives.

grizzly bears were present along one 4.2-mile (7-kilometer) stretch of a salmon stream and 15 individual brown bears were present at a 4.2-mile (7-kilometer) stretch of a different salmon stream. Grizzly bears den at middle to high-altitude ranges of the Brooks Range (Joly et al. 2016) and Ray Mountains (Eagan 1995; Jandt 1998). Black bears are an important subsistence species, and furbearers (e.g., wolf, wolverine) are targets of trapping for local communities for income and subsistence purposes. The population trends of large carnivores in or near the project area are largely unknown due to low density, large ranges, cryptic nature, and high mobility of the various species.

Small Mammals

Small mammals, including shrews, lemmings, voles, ground squirrels, and weasels, are important prey for predatory birds and carnivorous mammals in northwestern Alaska. Many small mammal species have cyclical population fluctuations reflected, with a short temporal lag, in the population fluctuations of their predators. For example, fox and lynx populations in northern Alaska are highly volatile and are closely associated with snowshoe hare abundance (Ruggiero et al. 1999; Yom-Tov et al. 2007). Furbearers, particularly lynx, marten, beaver, and fox, are harvested by trappers throughout the project area, but harvest numbers are relatively low throughout the region. Arctic ground squirrels hibernate during winter, while lemmings, voles, weasels, and shrews are active year-round. Most of these species are widely distributed and relatively common in a variety of habitats.

Little brown bat is the most widely distributed bat in Alaska; however, its presence within the project area is unknown. Little brown bats have been observed throughout interior Alaska, and observations from Bettles and Fort Wainwright are closest to the project area (Shively and Barboza 2017; Shively 2016; Savory et al. 2017). Maternity roosts have been identified at anthropogenic (i.e., buildings) and natural (i.e., trees) sites in Interior Alaska (Shively 2016; Shively and Barboza 2017). Tree roosts are generally located in deciduous and mixed open forests near rivers and ponds (Shively 2016; Shively and Barboza 2017).

Cook and MacDonald (2006) and MacDonald and Cook (2009) describe the habitat preferences of small mammals. The population trends of small mammals in or near the project area are unknown due to a lack of research. However, given the size of the study area and overall habitat availability, the BLM determined the missing information is not relevant to reasonably foreseeable significant adverse impacts.

Special Status Species

The BLM has confirmed with the USFWS (Swem 2020) that the ESA does not currently list any terrestrial mammals known or suspected to occur within the project area and there is no designated critical habitat located in the project area. The BLM designated the arctic ground squirrel, northern bog lemming, and little brown bat, each of which occurs in the project area, as watch list species (BLM 2019), and the state lists 16 mammal species as Species of Greatest Conservation Need (ADF&G 2015; see Appendix E, Table 18). Neither designation is associated with additional protections or stipulations.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

Under the No Action Alternative, the BLM and/or other federal authorizing agencies would not issue authorizations for the Ambler Road and therefore road construction and use would not occur. There would be no road impacts associated with AIDEA's proposal on mammals under the No Action Alternative. Mammals would be affected by changing climate and permafrost conditions, and other reasonably foreseeable future actions, as described in Appendix H. Air traffic to support mineral

exploration would continue under the No Action Alternative and could cause disturbance and displacement of caribou.

Impacts Common to All Action Alternatives

Potential impacts to mammals from construction and operation of the action alternatives could include habitat loss, alteration, and fragmentation; behavioral disturbance and displacement; and injury or mortality. The nature of the impacts is similar for each action alternative, but the magnitude of the impacts would vary based on differences in location and design of the action alternatives (see discussion below and in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). See Appendix E, Table 20, for a summary of potential impacts to terrestrial mammals, including effect type, extent, and duration. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Caribou Impacts

Construction of the action alternatives would result in the loss of caribou habitat in areas of vegetation removal and placement of gravel fill. Direct loss (i.e., not including indirect impacts or edge effects) of caribou habitat by herd, range type, and action alternative is shown in Appendix E, Table 20, which helps define the likelihood and magnitude of impact. Indirect impacts are discussed below, but they are not quantified because they are dependent on numerous variables, such as vegetation type, environmental conditions, and numerous aspects of the perturbations. The reduction of lichen-dominated vegetation types would result in disproportionately greater impacts on WAH than the reduction of other vegetation types, because of the importance of lichen as a food source. As shown in the table, each of the action alternatives would permanently remove habitat acreage in the winter, migratory, and peripheral ranges of the WAH caribou.

During winter, forage can be difficult to access and travel can be difficult due to snow cover. Loss of winter range would be more detrimental to the WAH than loss of migratory or peripheral range, although caribou must be able to access the winter range if development occurs along migration routes. Although habitat loss would occur under each action alternative, Alternative C would result in the greatest area of WAH winter range loss, while Alternatives A and B would result in greater total loss of WAH habitat, as discussed further below and in Appendix E, Table 19.

Macander et al. (2022) used remote sensing data to estimate the top cover of plant function types, including lichen, across much of Alaska. The mean percent top cover of lichen within 5 kilometers of each of the 3 alternatives was calculated (see Appendix E, Table 21). The percent of top cover represented by lichens was similar among alternatives but tended to be highest for Alternative B and lowest for Alternative A. The percent of lichen increased between 1985 and 2020 for all 3 alternatives. The median snow depth was highest along Alternatives A and B, and the median snow depth along Alternative C was similar to the average snow depth across the winter range (see Appendix E, Table 21).

The ADF&G maintains radio collar and satellite telemetry data for the WAH in cooperation with the BLM, NPS, and North Slope Borough (NSB). These data provide multiple locations of each caribou. Until recently, most WAH caribou were collared while crossing the Kobuk River in the fall (Dau 2015), telemetry locations during the first fall and winter were removed prior to analyses to allow newly collared caribou to mix with the rest of the herd and ensure that collared caribou are representative of the herd as a whole (Prichard et al. 2022b). A kernel density estimation (KDE) technique was used to approximate seasonal range use for the collared cohort as a representative sample of the entire WAH using the methods outlined in Welch et al. (2022). In addition, the percentage of individual collared animals in an area was calculated from the 95 percent utilization distribution of dynamic Brownian Bridge movement models for each individual. The fall migration (September 18 to November 7) (Dau 2015) routes and

winter (November 8 to May 5) range use of female WAH caribou collared between July 1, 2002, and June 30, 2021, are depicted in Volume 4, Map 3-23. To show the shift in range use and migratory routes over the last 15 to 20 years, the data are represented in 5-year increments in Volume 4, Map 3-23. Winter range use is displayed as high-, medium-, and low-density (50, 75, and 95 percent of collared individuals, respectively) utilization contours in Volume 4, Map 3-23. Using these data results in concentrated ranges compared to the entire WAH range because the data are based on a small number of years. As such, the winter range use and fall migration areas shown in Volume 4, Map 3-23, should be interpreted as supplemental to rather than superseding the ADF&G range maps.

Together, all the caribou maps and tables help to illustrate the extent of caribou movements in relation to the road alternatives and help to define the extent and likelihood of potential impact. Direct habitat loss within the high-density winter range for each 5-year period and under each action alternative is provided in Appendix E, Table 19, helping to define the magnitude of impact. As shown on Volume 4, Map 3-23, which illustrates the extent of potential impacts, fall migration has become more concentrated southwest of Kobuk as a result of shifting winter range use. Each of the action alternatives overlaps with fall migration routes near Kobuk. Winter distribution has shifted over this period. Because WAH range use is dynamic, seasonal herd concentrations may overlap with the action alternatives in any given year. The impacts of the Ambler Road on WAH described below have the potential to occur at any point along the action alternatives that the caribou may occur, as range use may shift in the future for anthropogenic or natural reasons.

The available telemetry data for the WAH was also used to calculate the percentage of the winter range that was within 3.1 miles (5 kilometers) and 30 miles (48 kilometers) of each alternative during different years based KDEs of annual winter range distribution of female caribou (see Appendix E, Table 22). A distance of 3.1 miles was used based on the largest displacement distance reported by Johnson et al. (2020) and a distance of 30 miles because a subset of WAH caribou migrating past the DeLong Mountain Transportation System (DMTS) road exhibited changes in movement as far as 30 miles from the road (Dau 2023; Wilson et al. 2016). There is limited data available for displacement during winter. Some early years were combined due to low sample sizes of collared caribou. These delineations of annual winter ranges were also used to identify areas that were used repeatedly for annual wintering areas (defined as the 95 percent isopleth from KDE) and high-density wintering areas (defined as the 50 percent isopleth from KDE). The number of years a mile of road was within the wintering or high-density wintering area was calculated as a metric of how important that area was to WAH caribou (see Appendix E, Table 23). The percentage of female caribou with GPS collars that crossed an alignment was also calculated for different seasons and different years (see Appendix E, Table 24).

Tundra vegetation adjacent to gravel roads can be affected by the deposition of dust and gravel spray from vehicle traffic, alterations to drainage patterns from drifted snow, impounded drainage, spills of hydrocarbons or other contaminants, and the potential for introduction of nonnative plants. Of particular concern for caribou are the impacts of dust deposition on lichen communities. Declines in lichen cover have been detected up to 3,280 feet (1,000 meters) from gravel roads on the North Slope and in the Red Dog Mine area in northwest Alaska (Chen at al. 2017; Gill et al. 2014; Myers-Smith et al. 2006; Neitlich et al. 2017; Walker et al. 2022). In the Prudhoe Bay oilfield, lichens were absent in 2014 from all sampling plots within 50 meters of a heavily traveled gravel road that was constructed in the 1970s (Walker et al. 2022). Road dust affects lichens and other cryptogams by increasing soil pH, as well as by direct smothering. Evergreen shrubs, forbs, and mosses also had lower cover near gravel roads, while cover of deciduous shrubs and graminoids may increase (Myers-Smith et al. 2006, Walker et al. 2022). A decline in lichen abundance in the vicinity of the road would result in a decrease in the amount of available winter forage, which could have negative impacts on caribou body condition, productivity, and survival. Fugitive dust from ore trucks traveling along the road between the Red Dog Mine and the port

site resulted in increased concentrations of zinc, lead, and cadmium and declines in lichen species richness, although mitigative measures to lower the amount of fugitive dust were put in place in 2003 (Neitlich et al. 2022).

Roads and other infrastructure also affect snow distribution patterns, leading to changes in snow depth and melting. Deep snow drifts along roads provide insulation that keeps the underlying soil relatively warm during the winter (Bergstedt et al. 2023). Along heavily traveled gravel roads, large quantities of dust accumulate on the surface of the drifts, increasing the albedo and leading to early melt. The combination of warmer soil and early snowmelt can result in increased vegetation productivity and spring forage availability in roadside areas. Roads can also affect local drainage patterns, resulting in wetter conditions on the "uphill" side where water is impounded. Resulting changes in plant community composition typically include reduced cover of evergreen shrubs, forbs, mosses, and lichens, while cover of graminoids and deciduous shrubs (primarily willows) increases. Willows along roads on the North Slope and in the Red Dog Mine area are often noticeably taller than those in undisturbed areas.

The presence of a road could result in an increase in human-started fires, but would also change fire management priorities and resource allocation (see Section 3.3.1, Vegetation and Wetlands). Therefore, in proximity of the road, fires may be smaller and of shorter duration. Loss of caribou forage, especially lichen, due to fires may be less common in the project area as a result of the road for several decades but then a buildup of fuels after decades of fire suppression may cause a larger loss of caribou forage in parts of the project area.

During construction, a winter construction access trail (i.e., a snow trail or ice road with ice bridges) would be used. During the winter, the impacts of this trail would be similar to those of a gravel road. Caribou would likely be displaced by some distance due to construction and use of the access trail. The winter construction access trail would have negative impacts on vegetation along the alignment that would reduce the available forage to any animals in the area.

Each action alternative would fragment the WAH caribou range. The effects of this fragmentation, could be pronounced because the range is currently largely unaltered from a natural state. If fragmentation limits caribou seasonal movements, it could result in large negative impacts on caribou survival and productivity. Fragmentation may result in reduced dispersion of individuals across the winter range and subsequent crowding in smaller habitat fragments (Dyer et al. 2002). A Fish and Wildlife Protection Plan would include several measures to minimize the effects of habitat fragmentation on mammals (see Appendix N, Section 3.3.5, Mammals).

Construction and use of the road would cause behavioral disturbance to and displacement of caribou due to human activity, including noise and light pollution (Murphy and Lawhead 2000; Shideler et al. 1986). Traffic levels on the proposed road would be relatively low compared to some other studies of caribou near roads (e.g., Curatolo and Murphy 1986; Leblond et al. 2013)—this Supplemental EIS predicts a range of potential traffic volumes, from 104 to 168 trucks per day during Phase 3 operation (see Appendix H), or 4.3 to 7 trucks per hour on average; however, the DMTS road to the Red Dog Mine with relatively low traffic levels (approximately 4 ore trucks per hour plus some additional traffic) resulted in large changes in migration patterns for some caribou (Dau 2023). Disturbance and displacement would occur during all phases of construction and operations and during road closure and reclamation. Behavioral disturbance could result in an increase in energy expenditure due to higher stress levels and an increase in startle and flight responses. Behavioral changes could result in reduced foraging rates and decreased mating success. Noise could also inhibit predator detection and intraspecific communication (Barber et al. 2010; Brown et al. 2012).

Caribou are most susceptible to disturbance during calving, when behavioral changes and displacement have been detected up to 2.5 miles (4 kilometers) from industrial activity on the North Slope (Cameron et al. 1992; Cronin et al. 1994; Dau and Cameron 1986; Prichard et al. 2020a). Recently, Johnson et al. (2020) found that caribou on the North Slope reduced their use of habitat within 3.1 miles (5 kilometers) of development during calving, up to 1.2 miles (2 kilometers) during post-calving. and up to 0.6 mile (1 kilometer) during the mosquito season. Most caribou avoid roads during calving even with low activity levels, but there is some evidence that inactive infrastructure does not cause as much displacement as active infrastructure (Prichard et al. 2022). Road crossing success is likely influenced by season, location, road design, traffic volume, human activity levels, and the motivation of the caribou to cross. Caribou in northern Alaska oilfields cross gravel roads or pads 2 to 3 times per day when mosquito and oestrid fly harassment is occurring (Prichard et al. 2020a), and some caribou use gravel roads and pads as oestrid fly relief habitat (Pollard et al. 1996, Prichard et al. 2020a).

Other studies have identified larger displacement zones: up to 6 miles (9.6 kilometers) from various forms of disturbance (Cameron et al. 2005; Duchesne et al. 2000; Edmonds 1987; Leblond et al. 2011; Nellemann et al. 2003; Plante et al. 2018; Schaefer and Mahoney 2007; Vors et al. 2007). Displacement distance is related to disturbance intensity and other factors. Leblond et al. (2013) found that caribou avoidance of a highway occurred up to 3.1 miles (5 kilometers) during and after modifications to increase vehicle traffic; however, the maximum traffic rates for this project would be several times lower than those in the study. Dau (2023) reported that caribou exhibited changes in direction within 30 miles (48 km) of the road to the Red Dog Mine during fall migration and attributed reactions at such long distances to caribou responding to the behavior of other caribou that had been closer to the road. The strongest reactions to human activity, as measured in displacement distance, occur in response to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994). However, caribou in northwest Alaska, especially those that have been recently hunted, react more strongly to snowmobiles and ATVs than to any other disturbance stimuli, including people on foot. This is because these vehicles are louder and easier to see than people, WAH caribou encounter them more frequently than other types of disturbance, they are often impossible to evade, and the consequences of encountering these vehicles is often fatal (Dau n.d.c). Habituation to development and human activity during calving does not appear to occur(Johnson et al. 2020; Prichard et al. 2020a). Disturbance during winter could result in increased movement rates (Leblond et al. 2013), constricted home range size, and less range fidelity (Faille et al. 2010). Displacement from winter range could affect access to forage and subsequently reduce fitness at a time of year when forage may already be limited due to snow conditions (Joly 2011; Joly et al. 2010). If implemented, construction timing windows recommended by the BLM (see Appendix N, Section 3.3.5, Mammals) could reduce, but would not eliminate, impacts to caribou during sensitive periods.

During construction and road closure/reclamation, the most disturbing stimuli to caribou would be construction equipment and air traffic. Caribou are more prone to displacement from areas with consistently high levels of disturbance, such as material sites, camps, and airstrips. Low-level aircraft may cause flight responses or temporary changes in caribou behavior (Maier et al. 1998; Reimers and Colman 2006). Subsistence hunters in northern Alaska have expressed concerns about aircraft influences on caribou (Georgette and Loon 1988; Halas 2015; Stinchcomb et al. 2020). Caribou response to aircraft generally increases with its vertical and horizontal proximity to the group, its noise level, and its rate of approach toward the group; however, caribou responses to aircraft are highly variable (Dau n.d.d). During road operation, the most common disturbing stimuli would be vehicle traffic. Moderate to high traffic volumes (more than 15 vehicles per hour) have been shown to delay or deflect large groups of caribou, however individual movement may be altered at lower volumes and slower rates of traffic (Cameron et al. 1979; Cronin et al. 1994; Curatolo and Murphy 1986; Lawhead and Murphy 1988). Dau (2023) reported that only approximately 4 ore trucks per hour plus some additional traffic on the DMTS significantly delayed and deflected fall WAH migrations during 1994–2015. There is also the potential that larger

vehicles operating on the proposed road may increase avoidance to a greater extent than estimated in previous studies that focused on smaller vehicles associated with public or oil field roads. During Phase 1 operation, the pioneer road would see low traffic volumes and slow travel speeds. During Phase 2 operation, the use of pilot cars and convoys would limit displacement impacts on caribou. During Phase 3 operation (a 2-lane road), traffic volume is difficult to predict without actual mine proposals and is dependent on mine development. This Supplemental EIS predicts a range of potential traffic volumes, from 104 to 168 trucks per day during Phase 3 operation (see Appendix H), or 4.3 to 7 trucks per hour on average, which is lower than traffic volumes in the studies; however, the road to the Red Dog Mine with relatively low traffic levels resulted in large changes in migration patterns for some caribou (Dau 2023; Wilson et al. 2016). Disturbance and displacement of caribou would be greatest during construction of Phase 1 and during operation of Phase 3.

Caribou that encounter the road may be impeded, causing delays in crossing the road, deflection of movements, or potentially prevention of crossing the road entirely by some individuals as observed at the road to the Red Dog Mine (Dau 2023; Wilson et al. 2016). Steep road embankments may hinder caribou from crossing, thereby furthering the effect of the road. During winter, steep snow banks may prevent caribou movement and reduce road crossings (Roby 1978) except on BLM-managed lands where this potential impact may be partially mitigated. Potential mitigation measures (see Appendix N, Section 3.3.5, Mammals) and design features proposed by AIDEA (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA), such as requiring vehicles to wait for caribou to cross and allowing for closure of the road during migration periods, should reduce, but not eliminate, these impacts. Examples from across the globe suggest that disruptions in ungulate migration often cause rapid population collapse (Bolger et al. 2008). However, in Alaska, the CAH has maintained connectivity between winter and summer ranges despite being intersected by the Dalton Highway (Nicholson et al. 2016); the Fortymile Herd has maintained movement and migration patterns despite being intersected by multiple highways and roads (Boertje et al. 2012); and the Nelchina Herd crosses multiple highways annually (ADF&G 2016). In recent years, the population of the Nelchina Herd has declined due to high overwinter mortality and low recruitment (ADF&G 2022b, 2023). These herds are smaller than the WAH and have more complex and restrictive hunting regulations. In Alberta, roads are a semi-permeable barrier to woodland caribou, with the greatest barrier effect evident during late winter (Dyer et al. 2002). Both the characteristics of road designs and human activity levels associated with a road, as well as the level of motivation caribou have to cross the road, affect the crossing success of caribou.

As described above, local residents indicate that the historical caribou distribution in the project area shifted following the construction of TAPS and the Dalton Highway. Prior to construction of the pipeline and road, caribou migrated through the eastern portions of the project area, near Bettles, Alatna, and Allakaket. Following construction, residents say that the caribou stopped coming through this area (WAH WG 2015, 2016). These observations could be due to TAPS and the Dalton Highway, but may not necessarily have been of WAH caribou. Seasonal distributions of the HHH, CAH, Teshekpuk Herd, or Porcupine Herd may also have been influenced by pipeline or road development. Alternatively, the observed changes could be explained by stochastic shifts in range use as a result of natural perturbations.

In a study of the 52-mile DMTS road that services the Red Dog Mine, 8 of 28 GPS-collared caribou (29 percent) exhibited large alterations in their movements near the road during fall migration and took an average of 33 days (approximately 10 times as long) to cross the road. However, crossings by the other collared caribou (71 percent) did not appear to be delayed, and connectivity to seasonal ranges was maintained (Wilson et al. 2016). Dau (2023) also analyzed caribou telemetry data near the DMTS for the period 1994–2015 and created maps of movements for each satellite-collared caribou (even those that produced only 1 location/6 days) that moved within 30 miles of the DMTS. Dau (2023) classified caribou as either "affected" or "not affected" by the DMTS based on the criteria that any caribou that changed its

general direction of travel > 90 degrees in 2 consecutive periods was considered "affected"; all other collared caribou were deemed "not affected." Dau (2023) also created 2 animations, 1 for 2011 (when approximately 80,000 WAH caribou were delayed by the DMTS) and 1 for 2015 (when approximately 20,000 caribou were delayed) that showed fall movements of all satellite-collared WAH caribou within the western portion of their range. In each of the animations, caribou that migrated south through areas > 30 miles east of Red Dog (i.e., did not contain any type of development structures) were not delayed or deflected while caribou that migrated within 30 miles of the Red Dog Mine road were delayed up to 2 months, and 4 satellite-collared caribou never crossed the road (all died that winter north or northwest of the road). Recent studies of WAH movements have also shown that the current movements of the herd generally avoid existing roads (Baltensperger et al. 2019; Fullman et al. 2021). Fullman et al. (2021) used circuit theory to estimate how new roads may alter the distribution of caribou for subsistence harvest.

According to ADF&G studies, although delays and deflections of individuals may occur, and changes to localized movement patterns may result with potential impacts to caribou energetics and subsistence harvest, the migratory patterns of the WAH as a whole would likely remain intact unless the road creates a barrier to movement. Although caribou generally do not use specific migratory or seasonal movement paths every year, in many recent years, the majority of WAH caribou migrate west of the proposed action alternatives (Dau 2015). Impacts to WAH caribou during winter movements would be localized and limited as movement rates are lowest during mid to late winter (Dau 2015; Joly 2011). During the period of approximately 1996–2015, the majority of WAH caribou wintered on and near the Seward Peninsula, southwest of the action alternatives (see Volume 4, Map 3-22). However, it appears that winter abundance is shifting towards the Brooks Range with higher use of the project area (Parrett 2019; see Volume 4, Map 3-23). The potential impacts on WAH caribou are described separately for each action alternative below. The potential impacts on RMH caribou are described under Alternative C, below, and potential impacts on HHH caribou are discussed under Alternatives A and B, below.

As described in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA and Appendix N, Section 3.3.5 (Mammals), design features and potential mitigation measures include several measures intended to reduce disturbance to caribou and facilitate movement across the road. Some of these mitigation measures would be similar to those currently used on the DMTS road. Although these measures should be effective in reducing some of the behavioral disturbance and displacement impacts described above, available literature from the DMTS road (Dau 2023; Wilson et al. 2016) suggests that the measures are not very effective, and therefore behavioral disturbance, and displacement should be anticipated.

Injury and mortality of caribou may occur as a result of the road and airstrips. Collisions on the DMTS road are rare: 11 caribou fatalities were reported between January 2004 and November 2017 (Teck 2018). Caribou density along the DMTS is likely much higher than within the project area, except possibly the westernmost 40 to 50 miles of each action alternative. However, the DMTS road is located in open tundra; higher collision rates could be expected in forested or mountainous sections of the action alternatives, such as within the Ray Mountains or foothills of the Brooks Range, where sight lines are reduced. Although preventive measures would be taken to reduce collisions (Chapter 2, Section 2.4.3, Features Common to All Action Alternatives), caribou may be struck by aircraft and trucks and other vehicles (Aviation Safety Network 2020). The potential for vehicle collisions would be greatest during operation, particularly during Phase 3 when traffic volumes and travel speeds are the highest. Caribou may be attracted to the road as a movement corridor, to escape insect harassment, or during spring when the roadsides are the first to green up (Murphy and Lawhead 2000; Prichard et al. 2020a). The potential for collisions is highest in areas with limited sight lines.

Changes in hunter use may occur as a result of the road. rTespass use by sport or subsistence hunters, should it occur, could increase harvest close to the road. The experience with other roads in Alaska

suggests that some trespass by hunters is likely to occur. While gates may keep highway vehicles from accessing the road from the Dalton Highway, hunters on snowmobiles and ATVs would be able to bypass the gates and access the road between the gates. If the road is eventually opened to the public, this could result in higher levels of human activity along the road, higher levels of recreational use of areas adjacent to the road, and higher levels of hunting and trapping. Although, regulation of hunting and could partially mitigate the impacts of increased hunter access on caribou, these increases in human activity would likely increase the energetic impacts to caribou along the road and decrease the use of the area by caribou.

Predators, such as wolves and bears, may use the road corridor to more efficiently gain access to caribou (Dickie et al. 2017; DeMars and Boutin 2017; McKenzie et al. 2012; Wittington et al. 2011). Some caribou subsequently may actively avoid the road to avoid predators (DeMars and Boutin 2017), however, as described below, all action alternatives would intercept migratory movements, to varying degrees. James and Stuart-Smith (2000) found that, in a forested landscape, while caribou were near a road their risk of predation increased. Recent declines in caribou populations in northern Canada have been linked to increased predation in proximity to linear features (i.e., roads, seismic lines, and trails) (Hebblewhite 2017; Hervieux et al. 2013; McLoughlin et al. 2003). Wolf predation on caribou is a common concern raised by local residents. Although the road would be removed during closure and reclamation, a linear feature would remain, and predation rates may remain elevated for decades following closure.

Although unlikely, the road may prevent caribou from escaping wildland fires, resulting in fatalities. Roadside forage or waterbodies may become contaminated from chemicals associated with road construction and maintenance or deposition of mining byproducts released from trucks hauling ore (Hasselbach et al. 2005; Neitlich et al. 2017); this could affect animal health and is a concern for hunters consuming the meat. See also Sections 3.3.1, Vegetation and Wetlands; 3.3.2, Fish and Aquatics; and 3.4.7, Subsistence Uses and Resources, where bioaccumulation of pollutants and contamination of subsistence foods are discussed.

Other Large Herbivore Impacts

Construction of the action alternatives would result in the loss, alteration, and fragmentation of moose habitat. However, habitat disturbance can be beneficial to moose as it increases early successional browse availability. Moose abundance and density in the project area are low, particularly in the western half of the project area. Population estimates do not appear to be meeting management objectives, natural mortality is high, and harvest is currently restricted (Joly et al. 2017; Stout 2018). The locations of important calving and overwintering areas are not well known at this time, but local residents suggest important wintering grounds exist in the Alatna Portage area. For these reasons, impacts to important habitat areas are possible, may reduce productivity, and may result in localized population declines. Any reduction in the availability of moose to subsistence users would likely increase hunting demand for caribou and vice versa. Changes in population or demography would likely require changes in management strategies that may reduce harvest quotas or lead to implementation of predator control measures. Potential mitigation measures include a Fish and Wildlife protection plan and several measures to minimize habitat fragmentation for mammals (see Appendix N, Sections 3.3.2, Wildlife – General, and 3.3.5, Mammals).

Loss or alteration of muskox and Dall sheep habitat would not occur because both species rarely occur in the portions of the project area proposed for road development and for this reason the habitat there is not of high value to these species.

Disturbance and displacement of moose would likely occur, but the displacement distance and duration would be small. The full extent and nature of disturbance and displacement of moose cannot be predicted with certainty but would likely be greatest during all construction phases and during road closure and

reclamation, but would also occur during operation. Although moose tend to avoid roads, landscape features and browse availability are greater determinants of moose distribution in forested terrain (Bartzke et al. 2015). Moose also tend to habituate relatively quickly to anthropogenic disturbances (Harris et al. 2014) and may choose to use the road when deep snow impedes movement. Increased traffic volumes on the DENA road during the late 1990s did not appear to change abundance, distribution, or behavior of moose in the road corridor (Burson et al. 2000). In Norway, habitat alteration caused only minor changes in moose behavior but did result in greater separation of seasonal ranges (Andersen 1991). Steep road embankments may prevent moose from crossing the road. Potential BLM restrictions on activity during moose calving (see Appendix N, Section 3.3.5, Mammals) would be ineffective at reducing potential disturbance to moose during this sensitive period because the amount of BLM-managed land intersecting Alternatives A and B is small and the locations where moose calving occurs is unknown or difficult to predict.[71]

Although human activity may be noticeable to Dall sheep or muskox that are relatively close to the road, it is unlikely they would elicit behavioral reactions.

Injury and mortality of moose may occur as a result of the road, primarily due to trucks striking moose. Due to the low density of moose in the project area, collisions would likely be rare, but given the small population, even the loss of a few individuals could be detrimental. As discussed for caribou, above, the potential for vehicle collisions would be greatest during Phase 3 of operation when traffic volumes and travel speeds are the highest. Snowpack depth and proximity to winter range are positively correlated with collisions along railroads (the greater the snow depth, the higher the potential for collisions; Modafferi 1991). Moose may be attracted to the road as a movement corridor or during spring when the roadsides are the first to green up. Mowing and trimming of vegetation adjacent to the roads may increase new green browse for moose and attract them to the roadside. Moose often travel along riparian corridors and may cross the road close to or on bridges where it is not possible for trucks to avoid collisions.

Moose hunters often float rivers such as the Koyukuk, John, or the Malamute Fork of the Alatna. The presence of an industrial access-only road may deter recreational use and lower moose harvest rates in these areas. In addition, changes in the abundance or distribution of large carnivores may change moose predation rates. Predation, particularly high levels of calf predation, appears to be the limiting factor for this moose population (Joly et al. 2017; Longson 2019); therefore, a reduction in predators could increase the moose population. However, hypothetical changes in distribution may also increase predation in or near the project area.

Muskox and Dall sheep are unlikely to occur on or near the road, and therefore are unlikely to suffer injury or mortality as a result of the action alternatives.

Large Carnivore Impacts

Construction of the action alternatives would result in the loss, alteration, and fragmentation of habitat for large carnivores. Wolves, grizzly bears, black bears, and foxes are opportunistic predators with large ranges. For this reason, they are generally resilient to habitat loss unless it affects their prey. Changes to caribou or moose distribution and abundance could have cascading effects on bears and wolves. Wolf prey density in the project area is considered low (Johnson et al. 2017) and the availability of food resources for bears is limited (Hilderbrand et al. 2019); therefore decreases in prey abundance may reduce fitness and productivity of large carnivores. Local residents report that grizzly bears are common on the Malamute Fork of the Alatna River, and large aggregations of grizzly bears may occur along multiple

[71] The BLM determined there is sufficient information to make a reasoned choice among alternatives. The time and cost of obtaining additional detailed field information regarding moose calving areas would be exorbitant and would not be expected to add meaningfully to the overall assessment of alternatives.

salmon streams along the road alignments (Sorum et al. 2023). A road crossing a heavily used salmon stream may alter bear behavior, increase the risk of vehicle collisions, and could potentially result in avoidance of an important food source. Fragmentation of large ranges may alter distribution and predation patterns. Among potential mitigation measures is a Fish and Wildlife protection plan and several measures to minimize habitat fragmentation for mammals (see Appendix N, Sections 3.3.2, Wildlife – General, and 3.3. 5, Mammals); these may help to minimize impacts on BLM-managed lands.

Large carnivores may increase movement rates and movement duration due to road disturbance. Disturbance would occur during construction, operation, and during road closure and reclamation. Gardner et al. (2014) found that female bears with cubs that regularly moved between habitat patches early in the spring and those that were active during early morning, incurred higher cub mortality. Denning bears may be disturbed by nearby road construction, which may in extreme cases cause den abandonment, but would most likely only result in temporary spikes in heart rate and respiratory rate (Reynolds et al. 1983). A potential BLM mitigation measure may slightly reduce disturbance to denning bears because, under the measure, AIDEA would obtain locations of known bear dens and implement plans to avoid known bear dens (see Appendix N, Section 3.3.5, Mammals).

Roads can reduce wolverine habitat quality, elicit changes in movement patterns, and limit dispersal, especially among female wolverines (Scrafford et al. 2018, Sawaya et al. 2019; May et al. 2006). Scrafford et al. (2018) found that wolverines in northern Alberta avoided roads and roads reduced habitat quality, regardless of traffic rate. In addition, the pace of wolverine movement near roads increased with traffic volume (Scrafford et al. 2018). Studies have found that female wolverine are less likely to cross roads than males. This aversion to dispersal by females has led to genetic isolation and demographic fragmentation (Sawaya et al. 2019). Caribou are an important component of wolverine diet, both as prey and through scavenging carcasses. In northern Alaska, wolverines have been known to pursue caribou for long-distances (Magoun et al. 2018). Fragmentation of habitat by roads may interrupt predation events. Potential changes in caribou distribution and abundance, as discussed above, may also have cascading effects on wolverine. However, wolverines also tend to select alpine habitat which would be less affected by all of the action alternatives.

Injuries or fatalities of large carnivores due to vehicle collisions are possible, but would be rare. Bears and foxes may be attracted to human activity areas by real or perceived availability of food sources, such as trash. Use of disturbed areas by bears increases mortality rates (Berland et al. 2008). Bears and foxes may be killed in defense of life and property if they threaten people or become a nuisance. Measures to properly secure wildlife attractants and to discourage feeding of wildlife by AIDEA employees (see Appendix N, Section 3.3.5, Mammals) would be effective in reducing human-wildlife conflict, if implemented. Changes in distribution of hunting and trapping, or interference with long-established traplines, due to the road may increase or decrease harvest levels for some large carnivores.

Small Mammal Impacts

Construction of the action alternatives would result in loss, alteration, and fragmentation of habitat for small mammals. At the individual level, habitat would be lost directly through road construction and alteration of areas nearby may cause abandonment of habitat. Small mammals often occupy relatively small or restricted home ranges. Loss or fragmentation of this habitat could have severe consequences at the individual level. Some small mammals may be unable to disperse to available adjacent habitats. Changes in distribution may cause increased competition for resources or increased risk of predation. Although it is unlikely these impacts would accumulate to cause changes at the population level, currently available information on habitat value for most small mammal species is unavailable. Therefore, potential impacts cannot be quantified.

Small mammals may be locally displaced from suitable habitat. They may move in to lower quality habitat where competition for resources or risk of predation increases. In general, it is assumed that small mammal habitat is abundant and widespread across the project area, and alternate habitats are available for most small mammals. However, due to the fine-scale of small mammal habitat associations and a lack of detailed habitat mapping, impacts to small mammals from disturbance and displacement is difficult to predict.

Construction, operation, and road closure/reclamation activities would result in mortality of small mammals. Removal and compaction of top soils would crush burrowing mammals. Contamination of soils or waterbodies, even in small amounts, may cause injury of small mammals. Removal of little brown bat tree roosts may result in mortality, particularly if this occurs during pup birth and rearing (June through early August). Changes in the current distribution of trapping due to the road may increase or decrease predation of some small mammals in the project area. Use of the road would result in mortality of small mammals when they attempt to cross the road. The presence of linear infrastructure may attract foxes, ravens, or birds of prey, which would increase predation rates on small mammals. While the construction and operation of the road would remove individuals from the population, the road would not affect small mammals at the species population scale. However, increased carrion would attract predators and result in mortality of these species while they scavenge on the road.

Alternative A Impacts

Caribou Impacts

Alternative A would result in the smallest gravel footprint and least amount of caribou habitat loss and alteration of the action alternatives. Impacts to WAH caribou range would be similar to Alternative B, but Alternative A would affect more winter range used by collared caribou (Joly 2019; Appendix E, Table 19, helps to illustrate the likelihood and magnitude of impact).

The percent top cover of lichen along Alternative A increased from 4.44 percent in 1985 to 5.00 percent in 2020 within the WAH winter range and increased from 4.56 percent in 1985 to 4.80 percent in 2020 within the high-density WAH winter range (see Appendix E, Table 21). The percentage of the WAH wintering distribution within 3.1 miles of Alternative A ranged from 0.003 percent in 2015 to 4.004 percent in 2021 (see Appendix E, Table 22). The percentage of the WAH wintering distribution within 30 miles of Alternative A ranged from 0.076 percent in 2015 to 40.639 percent in 2021 (see Appendix E, Table 22). A total of 9.88 miles of Alternative A are in areas used as high-density wintering areas in 5 years; 35.07 miles are in areas used as high-density wintering areas in 4 years; and 56.75 miles are in areas used as high-density wintering areas in 3 years (see Appendix E, Table 23; Volume 4, Map 3-23b). The entire alternative is in areas used as winter range at least 5 years (see Appendix E, Table 23).

Between 2009 and 2023, there were 491 collar-years (one caribou collared in 1 year equals 1 collar-year) for female caribou that were collared with GPS collars for at least 75 percent of the year (calculated as July–June). A total of 7.1 percent of these female caribou crossed Alignment A at least once during the year with the percentage of caribou crossing the road annually ranging from 0 percent to 31.0 percent (see Appendix E, Table 24). The crossing rates were highest in fall and winter and low in spring and late summer, no crossings occurred during other seasons (see Appendix E; Table 24). Most of the crossings occurred on the western side of the alignment (see Volume 4, Map 3-22). Compared to Alternative B, there were more crossings overall under Alternative A; however, the total number of crossings was not substantially different. In addition, preconstruction data is a poor indicator of caribou behavior following construction. Therefore, it is not clear whether Alternative A would have substantially different effects overall on disturbance and displacement of caribou than Alternative B. A limitation of this analysis is that

it is restricted to female caribou. Biologists tend to disproportionately collar female caribou because cow mortality and productivity is largely what drives population fluctuations.

Increased traffic on the Dalton Highway could disturb or displace HHH caribou under Alternatives A and B, but these impacts would not occur under Alternative C. Average daily traffic levels between the Yukon River and Gobblers Knob ranged from 180 to 250 vehicles between 2012 and 2017, with an average of 217 daily vehicles (DOT&PF 2017). Approximately two-thirds of these are commercial trucks as opposed to private vehicles (HDR 2018). Although few HHH caribou occur near the Dalton Highway, increases in traffic volume of 160 to 238 trucks during Phase 3 operation (see Appendix H) or an increase of 74 to 110 percent over current levels, may adversely affect this herd. HHH caribou may avoid using habitat west of the Dalton Highway, which could lead to avoidance of high-quality habitat and increased competition for resources in a restricted, lower-quality range. The potential for vehicle collisions with caribou would increase proportionally to traffic volume. Travel speeds would likely be higher than those on the Ambler Road, which would also increase the risk of collisions. The effects of increased traffic on the Dalton Highway may be amplified due to the relatively small population size and small range of the HHH.

Other Large Herbivore Impacts

Alternative A would result in the least amount of habitat lost or altered out of the action alternatives. In a study of 37 collared moose in and near the project area conducted between 2008 and 2013, 6 moose (16 percent of those collared) crossed the proposed Alternative A route a total of 156 times (Joly et al. 2016) Moose density is very low along the western half of Alternative A, including where Alternatives A and B diverge. Therefore, there is little to no difference in potential effects on moose between Alternatives A and B.

Large Carnivore Impacts

Alternative A would result in the smallest area of habitat loss and alteration of the 3 alternatives. In a study of 41 collared grizzly bears between 2014 and 2015, 17 bears crossed Alternative A a total of 209 times. Crossing rates were similar between Alternatives A and B, and most crossings were close to salmon streams. Grizzly bear dens have been identified in the southern Brooks Range above Alternatives A and B (Joly et al. 2016). Both Alternatives A and B avoid alpine habitat and therefore would not directly affect grizzly bear dens, but disturbance from road construction and use may affect denning bears in this area.

Small Mammal Impacts

Impacts on small mammals would be similar between Alternatives A and B, except that under Alternative A, slightly less habitat loss and alteration would occur than under Alternative B.

Alternative B Impacts

Caribou Impacts

Alternative B would result in 15 percent more habitat loss and alteration than Alternative A, but much less than Alternative C. Alternative B would affect slightly more ADF&G-mapped migratory and peripheral range than Alternative A, and less than half as much habitat used by collared caribou in the winter (see Appendix E, Table 19, helps to illustrate the likelihood and magnitude of impact). Despite these differences, the functional effect of Alternatives A and B on caribou would likely be the same.

Alternative B follows the same alignment as Alternative A for 73 percent of its route, and therefore would have similar impacts on caribou. The percent top cover of lichen along Alternative B increased from 4.44 percent in 1985 to 5.25 percent in 2020 within the WAH winter range and increased from 4.55 percent in

1985 to 5.23 percent in 2020 within the high-density WAH winter range (see Appendix E, Table 21). The percentage of the WAH wintering distribution within 3.1 miles of Alternative B ranged from 0.003 percent in 2015 to 4.035 percent in 2021 (see Appendix E, Table 22). The percentage of the WAH wintering distribution within 30 miles of Alternative B ranged from 0.076 percent in 2015 to 40.667 percent in 2021 (see Appendix E, Table 22). A total of 9.88 miles of Alternative B are in areas used as high-density wintering areas in 5 years; 35.07 miles are in areas used as high-density wintering areas in 4 years; and 25.55 miles are in areas used as high-density wintering areas in 3 years (see Appendix E, Table 23; Volume 4, Map 3-23b). The entire alternative is in areas used as winter range at least 5 years (see Appendix E, Table 23; see Volume 4, Map 3-23b).

Between 2009 and 2023, there were 491 collar-years for female caribou that were collared with GPS collars for at least 75 percent of the year (calculated as July-June). A total of 6.5 percent of these female caribou crossed Alignment B at least once during the year with the percent of caribou crossing the road annually ranging from 0 percent to 28.6 percent (see Appendix E, Table 24). The crossing rates were highest in fall and winter and low in spring and late summer, no crossings occurred during other seasons (see Appendix E; Table 24). Most of the crossings occurred on the western side of the alignment (see Volume 4, Map 3-22). Although there were more crossings overall under Alternative A, the total number of individuals was small and not substantially different. In addition, preconstruction data is a poor indicator of caribou behavior following construction. Therefore, it is not clear whether Alternative B would have substantially different effects overall on disturbance and displacement of caribou than Alternative A.

Potential impacts to the HHH due to increased traffic volumes on the Dalton Highway may occur, and would be identical to those described above for Alternative A, but Alternative C would avoid these impacts.

Other Large Herbivore Impacts

Moose densities are low across the project area. Therefore, potential impacts to moose from Alternative B would be similar to Alternative A, except slightly more habitat loss would occur under Alternative B.

Large Carnivore Impacts

In a study of 41 collared grizzly bears between 2014 and 2015, 16 bears crossed Alternative B a total of 192 times. Impacts to other large carnivores would be similar between Alternatives A and B, except slightly more habitat loss would occur under Alternative B.

Small Mammal Impacts

Impacts to small mammals would be similar between Alternatives A and B, except that under Alternative B, slightly more habitat loss and alteration would occur than under Alternative A.

Alternative C Impacts

Caribou Impacts

Of the action alternatives, Alternative C would result in the largest gravel footprint and most caribou habitat loss and alteration. While Alternative C would affect the least amount of WAH caribou range, it is the only action alternative that would affect RMH caribou range (see Appendix E, Table 19, helps to illustrate the likelihood and magnitude of impacts).

The percent top cover of lichen along Alternative C increased from 3.45 percent in 1985 to 4.53 percent in 2020 within the WAH winter range and increased from 4.21 percent in 1985 to 4.80 percent in 2020

within the high-density WAH winter range (see Appendix E, Table 21). The lichen amounts were lower in Alternative C compared to the other 2 alternatives. The percentage of the WAH wintering distribution within 3.1 miles of Alternative C ranged from 0 percent in 2015 to 4.597 percent in 2021 (see Appendix E, Table 22). The percentage of the WAH wintering distribution within 30 miles of Alternative C ranged from 0.009 percent in 2015 to 44.704 percent in 2021 (see Appendix E, Table 22). A total of 8.02 miles of Alternative C are in areas used as high-density wintering areas in 6 years; 20.60 miles are in areas used as high-density wintering areas in 5 years; 35.96 miles are in areas used as high-density wintering areas in 4 years; and 8.45 miles are in areas used as high-density wintering areas in 3 years (see Appendix E, Table 23; see Volume 4, Map 3-23b). A total of 192.13 miles were outside of the winter range of the WAH (see Appendix E, Table 23; see Volume 4, Map 3-23b).

Collared WAH caribou crossed the Alternative C alignment more often than Alternatives A and B. Between 2009 and 2023, there were 491 collar-years for female caribou that were collared with GPS collars for at least 75 percent of the year (calculated as July–June). A total of 10.6 percent of these female caribou crossed Alignment C at least once during the year with the percentage of caribou crossing the road annually ranging from 0 percent to 67.9 percent (see Appendix E, Table 24). The crossing rates were highest in fall and winter and low in spring and late summer; no crossings occurred during other seasons (see Appendix E; Table 24). Most of the crossings occurred on the western side of the alignment (see Volume 4, Map 3-22).

Unlike Alternatives A and B, Alternative C would intersect the range of the RMH and result in the loss of known summer and year-round range (see Appendix E, Table 19). The RMH is a small, non-migratory herd that occupies a relatively small and isolated range centered on the Ray Mountains. Little is confidently known regarding the seasonal distribution, migratory routes, diet, or other important life history and habitat use of this herd. Impacts from habitat loss and alteration, disturbance and displacement, and injury and mortality as described above could be more pronounced and of higher consequence to this herd than the WAH. Furthermore, the RMH population growth is limited by predation (Longson 2020; Pamperin 2015). Impacts from Alternative C that affect the population could be detrimental to the long-term viability of the herd.

Habitat loss would affect about 0.08 percent of the approximately 2.5-million-acre RMH range, including 0.23 percent of available summer range (see Appendix E, Table 19). There currently is no noteworthy anthropogenic disturbance located in the range of the RMH. Fragmentation of an already restricted range could constrict movement, increase crowding, and increase competition for limited forage (Vors et al. 2007).

Alternative C follows the upper Tozitna River drainage, which could be important winter, calving, or summer habitat, as RMH caribou were found there in each of those seasons during monitoring in the late 1980s and early 1990s (Hollis 2007; Pamperin 2015). Jandt (1998) identified the south slopes of the upper Tozitna River drainage as a core calving area. Alternative C would remove approximately 984 acres of alpine habitat in the Ray Mountains (see Appendix E, Table 10, helps to illustrate the magnitude of impact), which Jandt (1998) found to be heavily used during summer. Although this herd is non-migratory, it does undertake relatively short movements based on seasonal forage availability. Alternative C may impede access to important habitats. Implementation of potential seasonal restrictions on construction activities, specifically during calving (see Appendix N, Section 3.3.5, Mammals), would be important to reduce impacts to RMH caribou.

Other Large Herbivore Impacts

Alternative C would result in more habitat loss and alteration than the other action alternatives. Alternative C would cross more streams and would parallel rivers for large portions of the route. Moose

densities are moderate to high in this region, and moose may be locally abundant (BLM 2016a). Therefore, impacts to moose may be greater than for Alternatives A and B. However, the extent of the impacts and relative magnitude cannot be predicted because little is currently known about moose distribution, abundance, or habitat use near Alternative C.

Large Carnivore Impacts

Alternative C would result in more loss and alteration of habitat for large carnivores than the other action alternatives. Grizzly bear denning sites have been observed in the mountains surrounding the upper Tozitna River drainage (Jandt 1998). The Ray Mountains represent a somewhat isolated patch of medium quality grizzly bear denning habitat in Interior Alaska (Eagan 1995, as cited in BLM 2016a). Loss and alteration of habitat as well as disturbance from Alternative C could reduce or redistribute denning in this area. Construction and use of a road through alpine habitat may affect wolverines more under Alternative C than the other action alternatives.

Small Mammal Impacts

Alternative C would result in the largest amount of habitat loss and alteration of the action alternatives. Therefore, impacts to small mammals would be similar in nature to those described above, but would be greater than the other action alternatives.

Combined Phasing Option

Caribou Impacts

The combined phasing option would largely affect caribou through changes in the timing of specific impacts. The Phase 1 pioneer road would have the lowest impact on caribou due to low traffic levels, but construction activity may have a large impact on caribou if it occurs during periods of time when caribou are present. Combining Phase 1 and Phase 2 mean that the larger impacts of Phase 2 would begin earlier, but there would be less construction activity. Combining Phase 1 and Phase 2 into a single construction period would reduce the duration of construction activity and the amount of mobilization required for the construction. It is possible, that initially exposing caribou to a small pioneer road may increase their tolerance of the larger Phase 2 road, but because winter ranges vary annually and by animal, this effect may be small, and this type of habituation to activity along a road may not occur (Johnson et al. 2020).

Other Large Herbivore Impacts

Impacts to moose and other large herbivores would be similar to the impacts on caribou, except that moose are likely to be in the area year-round and therefore there is less opportunity to mitigate the impacts of construction activity by adjusting the seasonal timing of activity.

Large Carnivore Impacts

Impacts to large carnivores from the combined phasing option would also be largely based on changes in the timing of activities. A larger Phase 2 road would be present sooner, however there would be less overall construction activity.

Small Mammal Impacts

There would be little change in the impacts to small mammals from the combined phasing option. The amount of direct habitat loss resulting from gravel placement would be similar, although the timing would change. Decreasing the total construction period may result in a reduced impact to small mammals.

Mining, Access, and Other Indirect and Cumulative Impacts

Caribou

The cumulative effects analysis area for caribou includes the entire range of the WAH, RMH, and HHH. The past and present actions that have affected caribou throughout the analysis area are described in Appendix H, Section 2.3 (Past, Present, and Other Reasonably Foreseeable Actions), and the consequences of those actions are described above. Notable past actions that have affected WAH caribou include North Slope oil exploration and extraction, particularly in the northeast NPR-A, including construction of TAPS and the Dalton Highway; passage of ANILCA, resulting in establishment of national parks and national wildlife refuges throughout the analysis area; construction and operation of the Red Dog Mine and the DMTS; reindeer herding on the Seward Peninsula; increased sport hunting; and climate change. The WAH population grew rapidly from the 1970s to early 2000s, but has declined over the last 10 to 15 years (see Appendix A, Figure 3-1). Traditional knowledge from local residents suggests there have been dramatic changes in caribou distribution over the last 50 or more years (WAH Working Group 2015, 2016). Since the 1980s, declines in overall lichen abundance have occurred due to caribou overgrazing, wildfire, and climate change (BLM 2019; Joly et al. 2006, 2007).

RFAs that may affect caribou within the analysis area are described in Appendix H, Section 2 (Reasonably Foreseeable Actions). These include the mining development scenario, indirect road access scenario, and other actions located throughout the range of the WAH. For example, new oil and gas development in the NPR-A, expansion of the Red Dog Mine, development of a graphite mine north of Nome, and small-scale development (e.g., placer mines) in communities of the North Slope and Northwest Alaska boroughs could affect WAH caribou outside of the project area. In addition, expansion of the Port of Nome and construction of a road and deep-water port near Kotzebue could result in an increase the amount of new development occurring in these areas and could lead to increased interest in connecting the west coast to the Ambler Road in the future. Impacts in this area could affect caribou during calving, post-calving, or summer. Habitat impacts in these ranges could have greater impacts than similar amounts of habitat loss in other range types. Disturbance, particularly during calving and post-calving can affect survival and productivity.

The indirect and cumulative impacts from development of mines within the District and secondary access roads, and other development or activities elsewhere in the WAH range would be additive to the impacts to caribou described above and synergistic with the action alternatives. Environmental analysis and permitting for impacts of future development would be expected at the time of that development. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of migratory and winter range. Habitat impact due to the anticipated mines is predicted to be thousands of acres, not including access roads (see Appendix H, Table 2-10). Secondary access roads connecting communities could range from a few miles to over 100 miles in length (see Appendix H, Table 2-11). The mines, mining roads, and secondary access roads would increase habitat fragmentation exponentially. Noise impacts similar to those discussed in Chapter 3, Section 3.4.4 (Visual Resources) would be expected to occur and contribute the habitat fragmentation. If illegal trespass occurred along the roads, or if the road was eventually opened to public use, it would increase the level of disturbance and habitat fragmentation and could result in higher levels of mortality from hunting and vehicle collisions. The fragmentation of habitat would further remove usable habitat for caribou during migration and winter, which could force range shifts, increase competition for resources, or increase predation (NCASI 2008).

Active mines include large vehicles, machinery, blasting, airports, helicopter activity between airports and remote areas, and humans on foot, all of which may disturb caribou and result in displacement. In Newfoundland, caribou avoided areas within 2.5 miles (4 kilometers) of an active mine (Weir et al. 2007).

Boulanger et al. (2012) observed decreased probability of occurrence out to 8.6 miles (14 kilometers) from an active mine in the Northwest Territories. In Quebec and Labrador, caribou avoidance of an active mine ranged from no displacement up to 14.3 miles (23 kilometers) (Plante et al. 2018). Migrating caribou would encounter a network of active roads and industrial development that does not exist elsewhere in their range. It is much more likely that a system of roads would jeopardize long-distance migration than any single road (Joly et al. 2018). Increasing road density in the Kuparuk field resulted in avoidance and changes in distribution of the CAH on the Arctic Coastal Plain during calving. Areas of high road density resulted in up to 86 percent declines in caribou use of those areas (Nellemann and Cameron 1998), and subsequent shifts in distribution to other areas. Also, caribou on the Arctic Coastal Plain reduced their use of habitat close to development during calving, post-calving, and the mosquito season (Johnson et al. 2020). There is concern that multiple intersecting roads may create a corralling effect on caribou, which could delay their movement, increase stress levels, or prevent access to suitable habitat (NSB 2014).

Contamination of local forage and waterbodies with hazardous mining waste, mining dust, or other contaminants due to spills, accidents, or non-point source leaks could occur, despite potential mitigation measures to prevent spills and procedures to clean up contaminated soils and water and would be harmful to caribou. Traffic on mining access roads would increase collision potential. Changes in hunting activity may either reduce pressure or increase pressure in areas of increased density away from the District.

Similar impacts on caribou as described above could occur from additional roads. However, the resulting road networks could increase the magnitude of impacts on caribou, and mining activities could result in a greater intensity of disturbance and displacement (Boulanger et al. 2021; Eftesøl et al. 2019) or exposure to contaminants. If there is illegal trespass on the project road or these additional roads, it could result in higher levels of harvest, increased displacement from roads, and higher energetic expenditures from disturbance. If the road is eventually opened to the public, this could result in higher levels of human activity along the road, higher levels of recreational use of areas adjacent to the road, and higher levels of hunting and trapping. While regulation of hunting could partially mitigate the impacts of increased hunter access on caribou, increases in human activity would likely increase the energetic impacts to caribou along the road and decrease the use of the area by caribou. Also, complicated and restrictive regulations would impact subsistence users (Wolf and Walker 1987). These activities would occur in addition to habitat loss and human activities in WAH summer range or elsewhere on their migratory range.

The BLM is currently preparing an EIS regarding potential revocation of ANCSA 17(d)(1) withdrawals, including parcels in the Kobuk-Seward planning area within the WAH range. Revocation of withdrawals on certain parcels of land could result in changes in land management status, including an increase in the level of development allowed on those parcels. Changes from federal to state management could also impact subsistence harvest as reported in Section 3.4.7 (Subsistence Uses and Resources). Other development projects include potential infrastructure projects (e.g., OTZ Telephone Cooperative communication project).

Finally, climate change would act synergistically along with other cumulative actions, and may increase wildfires, alter predator-prey dynamics, change forage availability, quality and distribution, or increase the prevalence of extreme winter weather events (Hinzman et al. 2005). Rain-on-snow events can greatly limit access to winter forage for caribou and are expected to increase in frequency as a result of climate change (Bartsch et al. 2023; Bieniek et al. 2018). An increase in shrub cover and a decline in lichens growing on soil has been documented in the western Canadian Arctic (Fraser et al. 2014). Although not all impacts of climate change are negative, climate change may have been a factor in a 56 percent decline in populations of migratory caribou and wild reindeer across the Arctic over the last 2 decades (Russell et al. 2019). The reasons for these widespread, sometimes dramatic declines in *Rangifer* are not completely

understood, but some declines may be related to changing vegetation, increasing prevalence of diseases, rain-on-snow events, changing moisture regimes, increasing periods and intensity of insect activity, and other expected changes from climate change. Habitat fragmentation or displacement resulting from development may limit the ability of caribou to withstand and adapt to climate change.

Few past and present actions have affected the RMH and HHH. Wildfire, climate change, and fluctuations in predator abundance have likely affected RMH and HHH caribou, but the magnitude and extent of these effects have not been studied. Construction of TAPS and the Dalton Highway have likely affected the distribution of RMH and HHH over time. Only Alternatives A and B would directly affect HHH caribou and only Alternative C would directly affect RMH caribou, as described above. Four clusters of state mining claims are noted in the Ray Mountains (see Volume 4, Map 3-23a). Under Alternative C, the development of these mining claims would be more likely to occur because of easier access. Development of mines in the Ray Mountains would result in indirect and cumulative impacts on RMH caribou. Due to the small population and restricted range of the RMH, development on this scale could affect the long-term viability of the herd.

Reasonably foreseeable actions not associated with AIDEA's proposal would affect caribou and caribou habitat. The impacts of climate change on caribou, described above, would occur equally under the action alternatives and No Action Alternative.

Climate change is proceeding at an accelerating pace in the Arctic. In northwestern Alaska, climate change and associated changes in weather patterns and temperatures are affecting disturbance (fire) regimes, land cover, insect abundance, disease prevalence, invasive species, and predator abundance (Mallory and Boyce 2018). Effects of climate change have been observed and are anticipated to increase rapidly throughout the century (Joly et al. 2006; Joly and Klein 2011). Tundra fires are expected to increase in size and frequency due to climate change. Burned areas generally shift from lichen to graminoid cover and persist for many years. Warmer temperatures will accelerate this transition and could result in regional declines in preferred winter forage for WAH caribou (Jandt et al. 2008). Joly et al. (2012) predicted a decrease in high-quality winter forage approaching 30 percent in WAH winter range due to climate change induced fires. An intensification of winter weather events (including increased snow depth) and increase in icing events may prevent access to forage and reduce fitness (Joly and Klein 2011; Mallory and Boyce 2018). An increase in early successional habitats combined with shifts in shrub cover could increase moose abundance as much as 19–24 percent (Joly et al. 2012). An increase in moose abundance would be followed by an increase in predators, such as wolves, which could in turn affect caribou populations. Warmer temperatures may also enhance insect populations that stress and irritate caribou and increase prevalence of disease vectors (Joly 2017; Mallory and Boyce 2018).

The indirect and cumulative impacts from development of mines within the District, development of secondary access roads, and other development or activities elsewhere in the WAH range would be additive to and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and increase fragmentation of migratory and winter range. Impacts on caribou similar to those described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on caribou, and mining activities would result in a greater intensity of disturbance and displacement. These activities would occur in addition to habitat loss and human activities in WAH summer range or elsewhere on their migratory range.

Finally, climate change would act synergistically with other cumulative actions and may increase wildfires, alter predator-prey dynamics, change forage availability and distribution, increase the severity and frequency of insect harassment, or increase the prevalence of harsh winter weather events.

Alternative C is the only alternative that would directly affect RMH caribou. Four clusters of state mining claims are noted in the Ray Mountains (see Volume 4, Map 3-25). Under Alternative C, the development of these mining claims would be more likely to occur than under other alternatives, because the road would make these claims more accessible. However, because there are not applications for mining permits on these claims, their development is possible but the nature of any development is more speculative. If these claims in the Ray Mountains were to develop during the lifetime of the Ambler Road, the developments would result in cumulative impacts on RMH caribou. Due to the small population and restricted range of the RMH, development on this large number of claims (14,820 acres) could affect the long-term viability of the herd.

The RFAs identified in Appendix H, Section 2.3.3 (Other Reasonably Foreseeable Actions), and Table 3-1 would affect caribou and caribou habitat in the analysis area. The RFAs that would result in land disturbing activities would act additively and synergistically with the action alternatives and result in similar impacts to those described above and in Chapter 3, Section 3.3.4 (Mammals), of the EIS. The impacts of climate change on caribou, described above, would occur equally under the action alternatives and No Action Alternative.

Other Large Herbivores

The cumulative effects analysis area for other large herbivores includes the project area and the ore transportation route south on the Dalton Highway to Fairbanks and via train to a port in Southcentral Alaska. The potential impacts of the action alternatives on other large herbivores are described above. The past and present actions that have affected large herbivores throughout the analysis area are described in Section 2 (Reasonably Foreseeable Actions), and the current condition of large herbivore populations and their habitat are described above. Notable past actions that have affected moose include: construction of the Dalton Highway and railroads from interior to Southcentral Alaska; passage of ANILCA, resulting in establishment of national parks and national wildlife refuges throughout the analysis area; establishment of ACECs intended to conserve and study large herbivores; establishment of the Koyukuk River Moose Hunter's Working Group; State of Alaska predator control measures; increased sport hunting; and climate change. The same past actions have affected Dall sheep and muskox. The Ray Mountains may have been historically occupied by Dall sheep, but they are not currently present (BLM 2016). Muskox reintroduction on the Seward Peninsula and Cape Thompson was an important past action for that species (BLM 2016).

RFAs that may affect large herbivores within the analysis area are described in Section 2 (Reasonably Foreseeable Actions) and Appendix H, Table 3-1. These include the mining development scenario, indirect road access scenario, and other actions, such as reintroduction of Dall sheep (BLM 2016) or expansion of muskox range in areas potentially affected by the action alternatives or cumulative actions. The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to other large herbivores throughout the analysis area would be additive to and synergistic with the action alternatives (see Appendix H) and impacts from climate change. The development of the District and secondary access roads would result in habitat loss, alteration, and fragmentation of ungulate habitat. Habitat loss due to the mines is predicted to be thousands of acres, not including access roads (see Appendix H, Table 2-10). Secondary access roads connecting communities could range from a few miles to over 100 miles in length (see Appendix H, Table 2-11). Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of ungulate habitat. The fragmentation of habitat would further remove usable habitat for moose and other large herbivores during winter, which could force range shifts, increased competition for resources, or increased predation (NCASI 2008). Moose may also be attracted to disturbed areas and habitat edges where early successional

vegetation is plentiful. If illegal trespass occurred along the roads, it would increase the level of disturbance and habitat fragmentation and could result in higher levels of mortality from hunting and vehicle collisions. If the road is eventually opened to the public, this could result in higher levels of human activity along the road, higher levels of recreational use of areas adjacent to the road, and higher levels of hunting and trapping in the area. Although, regulation of hunting could partially mitigate the impacts of increased hunting on large herbivores, these increases in human activity would likely increase the energetic impacts to large herbivores along the road. Similar impacts on moose as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on moose, and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on Dall sheep alpine habitat and approach the periphery of muskox range.

Active mines include large vehicles, machinery, blasting, and humans on foot, all of which may disturb moose and result in displacement. Moose would encounter a network of active roads and industrial development that does not exist elsewhere in their range. Contamination of local browse and waterbodies with hazardous mining waste, mining dust, spills, or other mining accidents could occur, despite potential mitigation measures to prevent spills and procedures to clean up contaminated soils and water, and would be harmful to moose. Traffic on mining access roads would increase collision potential. Increased traffic on the Dalton Highway and increased railroad traffic from Fairbanks to Southcentral Alaska may lead to increased moose mortalities along these transportation routes. Changes in hunting activity may either reduce pressure or increase pressure in areas of increased density away from the District.

Unlike the action alternatives, development of the District would likely affect alpine habitat where Dall sheep may be present. Habitat loss in alpine habitats could have a greater impact on alpine obligates like Dall sheep due to naturally limited and fragmented habitat patches. It is possible that some individuals from nearby muskox herds could enter the District; however, impacts to this species would likely be minimal as the mines would be located at the periphery of its range.

Climate change would act synergistically with other cumulative actions and may increase wildfires, change browse availability and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005). Climate change would be additive to the development of mines by reducing suitable habitat for Dall sheep. Reintroduction of Dall sheep to the Ray Mountains has been discussed (BLM 2016a). Alternative C would directly impact Dall sheep if they were present, or the presence of a road and its impacts on sheep may preclude reintroduction. Effects of climate change are proceeding at an accelerated pace in the Arctic. In northwestern Alaska, climate change and associated changes in weather patterns and temperatures are affecting disturbance (fire) regimes, land cover, insect abundance, disease prevalence, invasive species, and predator abundance (Mallory and Boyce 2018). Effects of climate change have been observed and are anticipated to increase rapidly throughout the century (Joly et al. 2006; Joly and Klein 2011). Tundra fires are expected to increase in size and frequency due to climate change. Following fires, early successional vegetation provides quality browse for moose. Warmer temperatures would cause a shift in shrub cover to higher elevations and an expansion of moose range.

The same upward shift in vegetation would reduce available habitat for Dall sheep. An intensification of winter weather events (including increased snow depth) and increase in icing events may prevent access to forage and reduce fitness for all herbivores (Joly and Klein 2011; Mallory and Boyce 2018). An increase in early successional habitats combined with shifts in shrub cover, could increase moose abundance as much as 19–24 percent (Joly et al. 2012). An increase in moose abundance would be followed by an increase in predators, such as wolves. Warmer temperatures may also enhance insect populations and increase prevalence of disease vectors (Joly 2017; Mallory and Boyce 2018).

The indirect and cumulative impacts from development of the District, development of secondary access roads, and other development or activities throughout the analysis area would be additive to and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of ungulate habitat. Impacts on moose similar to those described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on moose, and mining activities would result in a greater intensity of disturbance and displacement. The mines could encroach on Dall sheep alpine habitat and approach the periphery of muskox range. Climate change would act synergistically with other cumulative actions and may increase wildfires, change browse availability and distribution, or increase the prevalence of harsh winter weather events. Climate change would be additive to the development of mines by reducing suitable habitat for Dall sheep. Reintroduction of Dall sheep to the Ray Mountains has been discussed (BLM 2016). Alternative C could directly impact Dall sheep if they were present, or the presence of a road and its impacts on sheep may preclude reintroduction by the ADF&G.

Large Carnivores

The cumulative effects analysis area for large carnivores includes the project area and the ore transportation route south on the Dalton Highway to Fairbanks and via train to a port in south-central Alaska. The potential impacts of the action alternatives on large carnivores are described above. The past and present actions that have affected large carnivores throughout the analysis area are described in Section 2 (Reasonably Foreseeable Actions) of this document and are reflected in discussion of the Affected Environment above and in BLM (2016). Notable past actions that have affected large carnivores include construction of the Dalton Highway and railroads from Interior to Southcentral Alaska; passage of ANILCA, resulting in establishment of national parks and national wildlife refuges throughout the analysis area; establishment of ACECs intended to conserve and study large herbivores; establishment of the Koyukuk River Moose Hunter's Working Group; State of Alaska predator control measures; increased sport hunting and trapping; and climate change.

RFAs that may affect large carnivores within the analysis area are described in Section 2 (Reasonably Foreseeable Actions) and Appendix H, Table 3-1. These include the mining development scenario, indirect road access scenario, and other actions. The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to large carnivores throughout the analysis area would add to those from the action alternatives (see Appendix H). Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of carnivore habitat. Similar impacts on large carnivores as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on carnivores and mining activities would result in a greater intensity of disturbance and displacement. Development of the mines, in contrast to Alternatives A and B, would remove alpine habitat where wolverines are more common and would remove potential grizzly bear denning habitat. Habitat impacts due to the mines is predicted to be thousands of acres, not including access roads (see Appendix H, Table 2-10). Secondary access roads connecting the communities most likely to pursue access would be a few miles long (see Appendix H, Table 2-11). The mines, mining roads, and secondary access roads would increase habitat fragmentation exponentially. The fragmentation of habitat would lead to displacement, which could force range shifts into lower quality habitat or could increase intraspecific competition for prey and territories (NCASI 2008). If illegal trespass occurred along the roads, it would increase the level of disturbance and habitat fragmentation and could result in higher levels of mortality from hunting and vehicle collisions. If the road is eventually opened to the public, this could result in higher levels of human activity along the road, higher levels of recreational use of areas adjacent to the road, and higher levels of hunting and

trapping in the area. Although, regulation of hunting and trapping could partially mitigate the impacts of increased hunting on large carnivores, these increases in human activity would likely negatively impact large carnivore populations along the road.

Active mines include large vehicles, machinery, blasting, and humans on foot, all of which may disturb large carnivores and result in displacement. Carnivores would encounter a network of active roads and industrial development that does not exist elsewhere in their range. Tolerance of human activity varies among species, but wolves and wolverines are particularly sensitive to industrial activity. Contamination of local waterbodies or land with hazardous mining waste (especially due to a large spill or tailings breach) or mining dust could occur and would be harmful to all local wildlife, including the carnivores' prey species as described above. A spill or breach, especially into a waterbody, would affect fish and aquatic species and the effects would ripple through the predator-prey ecosystem. Traffic on mining access roads would increase collision potential. Increased traffic on the Dalton Highway and increased railroad traffic from Fairbanks to Southcentral Alaska may lead to increased mortalities along these transportation routes. Changes in hunting activity may either reduce pressure or increase pressure in areas of increased density away from the District.

Climate change would act synergistically with other cumulative actions and may increase wildfires, change prey abundance and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005). Climate change is proceeding at an accelerated pace in the Arctic. In northwestern Alaska, climate change and associated changes in weather patterns and temperatures, are affecting disturbance (fire) regimes, land cover, insect abundance, disease prevalence, invasive species, and predator-prey dynamics (Mallory and Boyce 2018). Effects of climate change have been observed and are anticipated to increase rapidly throughout the century (Joly et al. 2006; Joly and Klein 2011). As described above, an increase in early successional habitats combined with shifts in shrub cover, could increase moose abundance as much as 19–24 percent (Joly et al. 2012). This would increase wolf and bear prey availability. An intensification of winter weather events may reduce fitness in wolf populations (Mallory and Boyce 2018). Warmer temperatures may also enhance insect populations and increase prevalence of disease vectors (Joly 2017; Mallory and Boyce 2018).

The indirect and cumulative impacts from development of the District, development of secondary access roads, and other development or activities throughout the analysis area would be additive to and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of carnivore habitat. Similar impacts on large carnivores as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on carnivores and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on wolverine alpine habitat and potential grizzly bear denning habitat. Climate change would act synergistically with other cumulative actions and may increase wildfires, change prey abundance and distribution, or increase the prevalence of harsh winter weather events. The ADF&G manages populations of all species for continued viability. As indicated, populations may shift and individual may not successfully compete for habitat, but indirect and cumulative effects are not expected to put species or broad populations at risk in the study area.

Small Mammals

The cumulative effects analysis area for small mammals includes the project area and the ore transportation route south on the Dalton Highway to Fairbanks and via train to a port in Southcentral Alaska. The potential impacts of the action alternatives on small mammals are described above. The past and present actions that have affected small mammals throughout the analysis area are described in

Section 2 (Reasonably Foreseeable Actions) of this document and are reflected in the Affected Environment discussion in Chapter 3, Section 3.3.4 (Mammals) and BLM 2016. Notable past actions that have affected small mammals include: passage of ANILCA resulting in establishment of national parks and national wildlife refuges throughout the analysis area; increased sport hunting and trapping; and climate change.

The indirect and cumulative impacts from development of the District and secondary access roads, and other development or activities to small mammals throughout the analysis area would add to those from the action alternatives. Habitat loss and alteration due to the reasonably foreseeable development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of small mammal habitat. Impacts on small mammals similar to those described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on small mammals and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on the alpine habitat of arctic ground squirrel, hoary marmot, and pika, which would be additive with climate change and impacts to alpine habitat under Alternative C.

RFAs that may affect small mammals within the analysis area are described in Section 2 (Reasonably Foreseeable Actions). These include the mining development scenario, indirect road access scenario, and other actions (BLM 2016). Development of the District and secondary access roads would result in habitat loss, alteration, and fragmentation of small mammal habitat. Habitat impacts due to the mines is predicted to be thousands of acres, not including access roads (see Appendix H, Table 2-10). Secondary access roads connecting communities could range from a few miles to over 100 miles in length (see Appendix H, Table 2-11). The mines, mining roads, and secondary access roads would increase habitat fragmentation. The fragmentation of habitat would further remove usable habitat for small mammals, which could force displacement, increased competition for resources, or increased predation (NCASI 2008).

Active mines include large vehicles, machinery, blasting, and humans on foot, all of which may disturb small mammals and result in displacement. Small mammals would encounter a network of active roads and industrial development. Contamination of local browse and waterbodies with hazardous mining waste or mining dust could occur and would be harmful to some small mammals. Traffic on mining access roads would increase collision potential. Increased traffic on the Dalton Highway and increased railroad traffic from Fairbanks to Southcentral Alaska may lead to increased small mammal mortalities along these transportation routes.

Climate change would act synergistically with other cumulative actions and may increase wildfires, change predator abundance and distribution, or increase the prevalence of harsh winter weather events (Hinzman et al. 2005). Climate change is proceeding at an accelerated pace in the Arctic. In northwestern Alaska, climate change and associated changes in weather patterns and temperatures, are affecting disturbance (fire) regimes, land cover, insect abundance, disease prevalence, invasive species, and predator-prey dynamics (Mallory and Boyce 2018). Effects of climate change have been observed and are anticipated to increase rapidly throughout the century (Joly et al. 2006; Joly and Klein 2011). An intensification of winter weather events may reduce fitness in small mammal populations (Mallory and Boyce 2018). Warmer temperatures may also enhance insect populations and increase prevalence of disease vectors (Joly 2017; Mallory and Boyce 2018).

The indirect and cumulative impacts from development of the District, development of secondary access roads, and other development or activities throughout the analysis area would be additive to and synergistic with the action alternatives. Habitat loss and alteration due to the reasonably foreseeable

development of the District could equal or exceed that from the road itself (see Appendix H, Table 2-10) and exponentially increase fragmentation of small mammal habitat. Similar impacts on small mammals as described above would occur from additional roads. However, the resulting road networks would increase the magnitude of impacts on small mammals and mining activities would result in a greater intensity of disturbance and displacement. The mines would encroach on the alpine habitat of Arctic ground squirrel, hoary marmot, and pika, which would be additive with climate change and impacts to alpine habitat under Alternative C. Alternative C would traverse more truly alpine habitat than Alternatives A or B. Climate change would act synergistically with other cumulative actions and may increase wildfires, change predator abundance and distribution, or increase the prevalence of harsh winter weather events. While individuals would be most affected and populations may shift, the viability of species and broad area populations are not expected to be at risk.

Marine Mammals

It is anticipated that containerized ore would arrive at a Southcentral Alaska port facility (likely the Port of Alaska in Anchorage) by train from Fairbanks and the material would be offloaded directly into ships. While land-side modifications may be necessary (e.g., creating container staging areas, adding a specialized crane to dump containers into the ship), no in-water construction is anticipated to take place at the port as an indirect consequence of the action alternatives. The amount of ore shipment is anticipated to result in up to 2 additional vessel trips to the port per month based on operation of 4 mines (see Appendix H, Table 2-8). For context, vessels currently call at the port approximately 8 days per month. Marine mammals can be affected by vessel traffic through direct strikes and noise; however, all vessels would follow established marine transit routes where vessel traffic is a common and regular activity. All marine mammals, including ESA-listed species that may occur in or near the port, are habituated to marine vessel traffic.

3.4. Social Systems*

3.4.1 Land Ownership, Use, Management, and Special Designations*

Affected Environment

Land Ownership, Use, and Management

The study area consists of federal, state, Native, and other private lands. Volume 4, Map 3-24, shows land ownership, and Appendix A, Figures 3-3, 3-4, and 3-5, show land use and management boundaries in the study area. The following provides context:

- Alternative A crosses state-owned/managed lands (59 percent); federal lands under jurisdiction of the BLM (12 percent) and NPS (12 percent); lands owned by 2 Alaska Native corporations (15 percent); and "other" (2 percent), which includes rivers/water, local government lands, and private lands;
- Alternative B crosses state-owned/managed lands (64 percent); federal lands under jurisdiction of the BLM (11 percent) and NPS (8 percent); lands owned by 2 Alaska Native corporations (13 percent); and "other" (4 percent), which includes rivers/water, local government lands, and private lands; and
- Alternative C crosses state-owned/managed lands (2 percent); federal lands under jurisdiction of the BLM (82 percent); lands owned by 2 Alaska Native Corporations (15 percent); and "other" (1 percent), which includes river/water and private lands.

The *Ambler Mining District Access Environmental Overview Memorandum* (DOWL 2011b) generally describes the affected environment for land ownership, use, and management. Since its inclusion in the

Overview Memorandum; however, the ADNR has updated the *Northwest Area Plan for State Lands* (ADNR 2008), which covers a portion of the study area. This section summarizes the land ownership, use, and management of the study area, including any updates since the *Overview Memorandum* (DOWL 2011b).

Federal Lands. Land ownership in the study area is mostly federal, under the jurisdiction of the BLM, NPS, or USFWS depending on the land designation. These agencies manage some federal land in the study area as either National Park and Preserve or Wildlife Refuge. Congress provided for road access across the Western (Kobuk River) Unit of GAAR in the ANILCA Section 201(4)(b). Under ANILCA 201(4), Congress stipulated (1) the DOI "shall permit...access" for surface transportation to the District across the Preserve and (2) the Preserve "shall be managed" for the following purposes, among others, "to maintain the wild and undeveloped character of the area, including opportunities for…solitude." See also explanation in Chapter 1, Section 1.2.2, Project Development Background and History. The BLM has Resource Management Plans (RMPs) that provide a framework for management of lands under its jurisdiction (incorporated as follows by reference). The *Kobuk-Seward Peninsula Resource Management Plan*, Draft EIS (BLM 2006), applies to the western portion of the study area (see Appendix A, Figure 3-3). This plan presents the goals and objectives, land use allocations, and management actions covering public lands in the Kobuk-Seward Peninsula Planning Area. The *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) covers most of the study area, and the *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision* (BLM 1991a) covers the TAPS corridor at the eastern edge of the study area (see Appendix A, Figure 3-3). The Central Yukon and Utility Corridor RMP boundaries include 24 remote villages, 15 of which have Tribal entities, and the lands of 3 Alaska Native Claims Settlement Act (ANCSA) Regional Corporations (Doyon Limited, Arctic Slope Regional Corporation, Inc., and NANA Regional Corporation, Inc. [NANA]). The BLM currently is developing an RMP that encompasses the Central Yukon and Utility Corridor RMP boundaries.

When the BLM conveys land to a Native corporation under ANCSA, it may reserve rights known as 17(b) easements to the United States (BLM 2016b). The BLM established most 17(b) easements to provide for access to public lands and major waterways. There are multiple 17(b) easements within 5 miles of a proposed project alternative (see Volume 4, Map 3-27, and Appendix F, Table 2).

State Lands. The state manages most of its lands for multiple uses. Area land use plans govern management of state lands (incorporated as follows by reference). These plans provide management intent, land-use designations, and management guidelines that apply to state lands in the planning area. The *Northwest Area Plan* (ADNR 2008) covers the western portion of the study area (see Appendix A, Figure 3-4). In general, the plan indicates the state should keep its land in this area in public ownership and opens the area to mineral entry and development, and mineral, coal, or oil and gas leasing; however, land uses need to be consistent with the specific management intent of each unit (see ADNR 2008 for details). The *Yukon Tanana Area Plan* (ADNR 2014) covers the eastern portion of the study area, which is in the plan's Lower Tanana region (see Appendix A, Figure 3-4). In general, "the overall management intent for this region is to dispose of some land for agricultural and settlement, retain land with forestry values and (it is recommended) incorporate some of these into the Tanana Valley State Forest, and retain state land associated with mineral, habitat, and public recreation and to manage state land consistent with these values" (ADNR 2014:3-20).

The Alaska Department of Natural Resources (ADNR) has management authority for state lands including the land, water, tidelands, and shorelands of navigable waters within the State. This authority includes management of navigable waters, tidelands, and shorelands within and adjacent to the boundaries of federal lands, including conservation system units created under ANILCA. A map of these

waters can be found on the DNR website using the "Navigable Waters (Title Purposes)" layer: https://mapper.dnr.alaska.gov/map#map=4/-16632245.12/8816587.34/0. The state recognizes that final title on many waters has not been resolved.

As shown on Volume 4, Map 3-24, the state has selected lands from the federal government, and these selections still are pending. The state has also top-filed on Utility Corridor lands not currently eligible for selection, including lands associated Alternatives A and B. See also Appendix H, Section 2.3.2, Past and Present Actions.

Native Lands. The study area includes lands owned by NANA and Doyon Limited, regional corporations established under ANCSA. Within each of the regions are village corporations, some of which own the surface estate around their respective villages (e.g., Evansville) and some of which have merged their assets with the NANA (e.g., Kobuk, Ambler, Shungnak). In general, the regional and village corporations provide social and economic opportunities to their shareholders. Another land ownership consideration is lands granted under the Native Allotment Act of 1906, providing for the grant of up to 160 acres to individual Alaska Natives. The Secretary of the Interior grants Native allotments, typically as restricted-title properties. As shown in Volume 4, Map 3-24, the Native corporations have selected lands from the federal government, and these selections still are pending.

Other Lands. The western portion of the study area is located within the NAB (see Appendix A, Figure 3-5), a first class borough under AS 29. The NAB provides planning, platting, and land use regulations for borough areas (including within cities). Portions of Alternatives A and B are within the NAB Subsistence Conservation District and NAB Habitat Conservation District for the Kobuk River Sheefish and Whitefish Spawning Area. According to the NAB Code and NAB comments on the Draft EIS, these districts can accommodate roads, airports/airstrips, mineral exploration, development, and minor resource extraction, but the project applicant will need to apply for rezoning or a conditional use permit. For more information on NAB zoning requirements, see Chapter 9.12 of the NAB Code.

Most of the study area is outside an organized borough. There are several second-class cities and unincorporated communities within 50 miles of the proposed project alignments (see Appendix F, Table 1).

Subsurface Rights/Mining Claims. Under Alaska law, surface and subsurface property ownership are separate rights. The State of Alaska typically owns the subsurface rights to state- and privately owned property (excluding Native owned), while the BLM manages the subsurface rights on federal public lands. There are many mining claims in the project area, primarily clustered in the District (see Volume 4, Map 3-25). Mining claims grant the claimholder exclusive rights to locatable minerals, but not sand and gravel resources, in their claim area. Mining claims do not allow the claimholder to restrict access to public lands. Mineral rights often take priority over other rights, except on those areas considered "withdrawn" from mineral entry such as national parks, national monuments, and Wild and Scenic Rivers. Regional and village corporations own surface estate lands, but ANCSA conveyed subsurface rights to regional corporations.

Revised Statute 2477. Section 8 of the Mining Law of 1866 addresses Revised Statute 2477 (RS2477), which grants a public ROW across unreserved federal land for transportation purposes. To qualify as a RS2477 route, it must have been constructed or used when the land was unreserved federal land. The State of Alaska has identified more than 600 possible RS2477 routes, including several in the study area; see also Section 3.4.8, Cultural Resources). ADNR records indicate there are several trails asserted as RS2477 ROW with 5 miles of the proposed project alignments (see Appendix F, Table 3). Although asserted, the RS2477 routes on BLM managed lands have not been officially acknowledged.

Special Land Management Designations including Parks, Refuges, Protected Areas, Wilderness, and Wild and Scenic Rivers

Volume 4, Map 3-26, shows the special designation lands described below.

Wilderness and Wilderness Study Area. Congress designated GAAR, except the National Preserve portion, as Wilderness (ANILCA established wilderness in the park portion and allowed for a road in the Preserve). Congress also designated the northern portion of the Selawik NWR as Wilderness, which abuts Wilderness in the southern portion of Kobuk Valley National Park, located approximately 8 miles west of Ambler. The BLM assessed its lands in much of the project area and determined most have “wilderness characteristics.” However, the BLM does not manage these lands for these characteristics, so this analysis of Special Designations does not consider them further. See Section 3.4.3, Recreation and Tourism, regarding wilderness recreation experiences. No designated Wilderness Study Areas occur in the project area.

Areas of Critical Environmental Concern and Research Natural Areas. Through the existing RMP process, the BLM designated 11 ACECs and Research Natural Areas (RNAs) in the project area, as listed in Appendix F, Table 4, and shown on Volume 4, Map 3-26 (see *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* [BLM 1986] and *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision* [BLM 1991a]). These RMPs are being combined and updated in the Central Yukon RMP, which is currently in progress. As currently defined, ACECs (43 CFR 1610.7-2) protect areas where there is a historic, cultural, or scenic value; fish or wildlife resource; or another natural system or where there is a natural hazard present that has substantial significance and value or cause for concern and requires special management (BLM 2015). In BLM’s existing project-area plans, the BLM considers RNAs together with ACECs. RNAs (43 CFR 8223) provide management and protection of lands with natural characteristics (e.g., plants, animals, geology, soil, water) that are unusual or of scientific or other special interest. RNAs are areas established and maintained for the primary purpose of research and education.

Special Recreation Management Areas. The Dalton Highway “inner corridor” from the Yukon River to areas north of the Brooks Range is a Special Recreation Management Area (SRMA) governed by a recreation plan (BLM 1991b). See also Section 3.4.3, Recreation and Tourism.

National Park System Units. GAAR occurs across the northern part of the project area and includes designated Wilderness. Kobuk Valley National Park is at the western edge of the project area and includes designated Wilderness; however, this analysis does not address it further because of lack of anticipated effects from the proposed project.

National Wildlife Refuge System Units. The Kanuti, Koyukuk, and Selawik NWRs occur in the project vicinity. This analysis does not describe these NWRs further because of lack of anticipated effects from the proposed project. The Selawik National Wild River, located within Selawik NWR, is an exception and is addressed in the next paragraph.

Wild and Scenic Rivers. Congress has designated those portions of the Alatna (main stem), Kobuk, John, Tinyaguk, and North Fork Koyukuk rivers that are within GAAR as parts of the National Wild and Scenic River System (WSR). These designated WSRs are located in the project area, and Alternatives A and B would cross the Kobuk WSR, as Congress anticipated in ANILCA 201(4)(c). See also Section 3.4.3, Recreation and Tourism, which addresses river users who continue on these rivers beyond the WSR designations. The Selawik National Wild River is part of Selawik NWR, located on the western side of the project area. The headwaters, including lakes that provide for fly-in access, are closest to the proposed alternatives. The Selawik National Wild River is 1 of 2 spawning areas for sheefish in northwest Alaska.

Low divides connect the upper river to the Koyukuk watershed, and humans have used them for hundreds of years as a transportation route (USFWS n.d.). Hot springs occur in this area. Residents of nearby communities typically access them by snowmobile and have bath houses/cabins there. ADNR has management authority for state lands including the land, water, tidelands, and shorelands of navigable waters within the State. This authority includes management of navigable waters, tidelands, and shorelands within and adjacent to the boundaries of federal lands, including conservation system units created under ANILCA. A map of these waters can be found on the DNR website using the "Navigable Waters (Title Purposes)" layer: https://mapper.dnr.alaska.gov/map#map=4/-16632245.12/8816587.34/0. The state recognizes that final title on many waters has not been resolved.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to land use, management, or ownership, including special designation lands. Existing land uses within the study area would continue, including small-scale mineral exploration supported by air.

Impacts Common to All Action Alternatives

All action alternatives would cross land of multiple owners. The BLM has authority only over BLM-managed lands. Management relative to the proposed road, including mitigation measures, stipulations, terms and conditions required to minimize environmental impacts, would be the responsibility of each landowning entity. In general, Volume 4, Maps 3-24, 3-25, and 3-26, illustrate land ownership and land management areas that would be affected by the action alternatives. These maps help to illustrate the locations and extent of such impacts.

Land management agencies would have an oversight responsibility for operations within the authorized areas. This would entail additional work and costs for these agencies, including the BLM. Costs would be associated with issuing the authorizations, monitoring operations, and ensuring compliance with stipulations, terms and conditions over the life of the project. Fees paid to the land management agencies would be expected to cover most of these costs.

While the location and quantity of the impacts would vary under each action alternative, the type of impact would be similar, except with respect to GAAR and the Kobuk WSR, which Alternative C would not affect. No change in the broad pattern of underlying land ownership is anticipated as a result of the project because the project would not be a land conveyance but rather the entities would authorize use of their lands. Appendix F, Table 5, shows the amount of land by owner that would be within the authorized project area[72] and helps define the magnitude of impact. Alternative C affects more acres of land than the other action alternatives, especially BLM-managed land. Currently the land within the proposed project area is largely undisturbed, natural habitat, in use for low-intensity recreation and subsistence. This would change with authorization of any phase of the project to a transportation corridor with its supporting facilities. Similar to the CYFO Utility Corridor, the BLM in consultation with the authorization holder,

[72] Note: the ROW is generally 250 feet wide, centered on the road centerline, except where the toe-of-slope is outside that limit. In those locations, the ROW boundary was considered for this analysis to be 10-feet beyond the toe-of-slope limit to provide space for construction and maintenance access. The normal highway width including ROW in Alaska is 100 feet (AS 19.10.015(a)). The State of Alaska limited the access road for the Donlin Mine to a 150-foot ROW (Alaska DNR, Final Finding and Decision, January 2, 2020). The Dalton Highway is subject to a 200-foot ROW width specified by statute (AS 19.40.050).

may authorize other non-conflicting land uses in the area, but the main use would likely be for specific project activities. After road closure and reclamation, land use would be largely restored to its current use.

While state and federal management plans for the area do not specifically call for a road in the District, the plans allow for such activity in most areas (see more at Alternative A and B discussion below), and ANILCA allowed for a road at the GAAR Preserve. All action alternatives would require a Title 9 permit from the NAB. The permit may require stipulations to address potential land use conflicts.

The road would not have public access, which would limit the potential for future development along the road. The road may make it easier to transport construction material; AIDEA indicated in its application that "some commercial uses may be allowed under a permit process" (DOWL 2016a; see Appendix H, Section 2.2.1, Commercial Access Scenario, for details about commercial access). Communities may find it feasible to build new community facilities, housing, or other infrastructure, expanding the community's footprint and changing land use locally.

Appendix F, Table 4, identifies the special designation lands and amount of land each alternative would affect, helping to illustrate the magnitude of effect to the designation and the likelihood of effect to the protected features. Roads and traffic generally are not desirable in special designation areas. They are not normally allowed in designated Wilderness and may be subject to extra stipulations in other areas. All alternatives would leave the Dalton Highway within the SRMA, although at different locations.

AIDEA would make provisions for suitable permanent crossings of the authorized area for the public where the project crosses existing roads, foot trails, winter trails, RS2477 trails, easements (including ANCSA 17b public easements), or other ROWs or known routes identified through AIDEA coordination with subsistence communities in the region and land managers. Under a potential BLM mitigation measure, AIDEA would prepare a Public Access Plan (see Appendix N).

Any seasonal ice road would be constructed in the footprint of the proposed Ambler Road and would not change impacts.

Alternatives A and B Impacts

Alternatives A and B cross GAAR, through the Western (Kobuk River) Unit of the National Preserve. The NPS EEA is addressing impacts to GAAR. Typically, a road through these lands likely would not be considered a compatible land use, but Congress provided for a road to the District across the National Preserve in ANILCA 201(4)(b) (see also Chapter 1, Section 1.2.2, Project Development Background and History).

These alternatives cross BLM-managed lands for 25 miles at and west of the Dalton Highway. Otherwise, these alternatives cross considerably more state land than Alternative C. Appendix F, Table 5, illustrates the magnitude of effect to various landowners. Road construction is consistent with state and BLM management plans in the area of these alignments. Alternatives A and B are more likely to impact Bettles and Evansville, while Alternative C would not. The Alternative B alignment would impact slightly more land than Alternative A. Alternatives A and B would cross through a corner of the GAAR park and Wilderness boundary described in ANILCA (near the Koyukuk River at approximately road mile 25, and approximately 10 miles northeast of Evansville; see Volume 4, Map 3-29) but would do so on a Doyon Limited inholding within the boundary, so there would be no effect on NPS-managed land.

Alternative A would cross the GAAR Preserve and the Kobuk WSR near the designated Wilderness boundary. Lands on both sides of the boundary presently are managed for wilderness characteristics, high scenic values, and backcountry recreation. The difference is that Congress designated the northern area in

law as Wilderness, while the southern Preserve portion is managed as wilderness per NPS policy according to its management plan. Alternative B would cross the Preserve lands at least 7 miles south of the Wilderness boundary and away from potential views of people within the designated Wilderness and near Walker Lake, the common starting point for Kobuk River trips. Alternative A would cross the National Preserve for 26 miles, roughly paralleling the Wilderness boundary within approximately 1 mile for 16 miles, and it would cross the Kobuk WSR. Alternative B would cross the National Preserve for 18 miles at a distance of 8 miles or more from the Wilderness boundary, which would create less impact on management of the congressionally designated wilderness than Alternative A. Both would cross the Kobuk WSR. Alternative A would be within approximately 0.25 mile of the WSR for approximately 2 miles, while Alternative B would be within approximately 0.25 mile of the WSR for approximately 0.7 mile. The impacts to wilderness characteristics within both the Preserve and WSR cannot be eliminated or even meaningfully reduced by changes in road and bridge appearance or operations. However, the alternatives would not enter federal Wilderness lands. It must be noted that transportation or utility system (TUS) may be approved in designated wilderness in Alaska under ANILCA Title XI.

ANILCA Section 201 allows for a crossing of the Preserve and the Kobuk WSR. Both alternatives would alter the character of the WSR corridor, primarily by creating a road bridge over a river designated for its "wild river" characteristics, including free-flowing waters that are generally inaccessible except by trail, while the character would change in the vicinity of the bridge.

The preliminary design for Alternatives A and B shows the project affecting a small amount of Native allotment land (see Appendix F, Table 5) at 2 parcels located near MP 131 and MP 180, where a water source access road and a material site overlap the allotments. In final design, it would be possible to adjust the design slightly in these locations to completely avoid overlap with the allotments. However, the allotments respectively would be directly adjacent to the water access road and the material site. These allotments and other allotments within the study area would be at risk of direct and indirect impacts from the proposed road including but not limited to environmental contamination, wildland fire, trespass, loss of intended customary and usual use, disruption of subsistence use, disruption of cultural practice, and loss of quiet enjoyment. Adjacency could be considered a benefit (such as the ability to take deliveries of goods via the road) or an adverse effect (such as noise, dust, and disturbance) or both, depending on the individual owner's point of view. Several other Native allotments occur relatively close to the proposed Ambler Road (see Appendix H, Section 2.2.1, Commercial Access Scenario, for detail) and could see similar effects, diminishing with distance from the road.

The shared alignment would cross the SRMA near Dalton Highway MP 161 and just south of Chapman Lake, which is listed in BLM public materials as a recreation site for wildlife viewing. See also Section 3.4.3, Recreation and Tourism.

Alternative C Impacts

Alternative C crosses considerably more BLM-managed land than Alternative A and B and would not cross NPS-managed lands, including the Kobuk WSR. Generally, road construction is consistent (not inconsistent) with state and BLM management plans in the area of this alignment. Alternative C would be likely to impact Hughes, while Alternatives A and B would not. The Alternative C alignment would cross the Tozitna River North and South and Indian River existing ACECs (see Appendix F, Table 4, which defined magnitude of effect to ACECs). Placing a road across these existing ACECs, established to protect fish spawning and rearing habitat, increases the level of concern regarding impacts to water flows, quantity, and siltation. However, nothing in the *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) or ACEC plans prohibits road construction, and mitigation measures are likely to reasonably protect fish habitat. BLM's habitat plan for the Indian River ACEC

(Kretsinger and Will 1995) provides management guidelines. The Tozitna River ACEC plan (Knapman 1989) does not provide formal management guidelines. See also Section 3.3.2, Fish and Aquatics.

The preliminary design for Alternative C shows the proposed road overlapping Native allotment land and other private land (see Appendix F, Table 5). The largest Native allotment use is nearly 9 acres on an allotment near Kobuk. This is a location where the Ambler Road would use (and likely reconstruct) an existing road to the Kobuk River. The road under this alternative would not likely overlap with the Native allotment parcel, and in final design, it likely would be possible to reduce or eliminate overlap with this Native allotment. Similarly, at an allotment north of Hughes where the ROW overlaps the parcel, it is likely in final design that use of a parcel would be eliminated. In these cases, the road would be adjacent to the parcels. At another allotment immediately southwest of Kobuk Airport, a parcel is overlapped for access to a river bar for gravel extraction and likely would be temporary. These allotments and other allotments within the study area would be at risk of direct and indirect impacts from the proposed road including but not limited to environmental contamination, wildland fire, trespass, loss of intended customary and usual use, disruption of subsistence use, disruption of cultural practice, and loss of quiet enjoyment. Proximity to the Ambler Road could be considered a benefit (such as taking deliveries of goods via the road) or an adverse effect (such as noise, dust, and disturbance) or both, depending on the individual owner's point of view. Several other Native allotments occur relatively close to the road (see Appendix H, Section 2.2.1, Commercial Access Scenario, for detail) and could see similar effects, diminishing with distance from the road.

At a long, narrow private parcel on the eastern edge of the Ray Mountains, in a confined valley, Alternative C would run the length of the parcel, and the ROW would overlap a large portion of it. The road potentially would overlap with the west end of an airstrip, possibly partially grown over, and an undetermined development, and it would cross some visible trails. During final design, additional work could be done in consultation with the landowner to determine the best route, avoid existing development wherever possible, and provide for crossings of the Ambler Road for access to all parts of the property. It is likely the ROW could be narrowed in this area.

Combined Phasing Option

Under this alternative, there would be no impact differences when compared to Alternatives A, B, and C because the ROW and road width would not change.

Mining, Access, and other Indirect and Cumulative Impacts

Any of the action alternatives, combined with the mining projects and other developments, would indirectly and cumulatively impact land use and, in some cases, land ownership. The large patterns of land ownership would remain unchanged. General land use intent expressed in area management plans would be satisfied, but the authorization of new industrial uses of the road corridor and District would alter existing land uses in the process. The possible development of parallel transportation routes for users that do not have access to the proposed road is generally inconsistent with the management plans. While the alternatives would use differing proportions of land from different owners and different special designation areas, there is no major distinction among the action alternatives regarding overall land ownership or land use, beyond those differences discussed above as direct impacts.

The road would induce future actions as described Appendix H, Section 2 (Reasonably Foreseeable Actions), particularly mining at several mines within the District and along the eastern end of the road (e.g., the Roosevelt Project). The proposed project would change the demand for industrial land uses associated with mineral development, and more exploration and mining activity is likely. In the District and in a narrow band along the road, industrial land uses would displace some existing subsistence and

recreation uses. Residential and commercial uses in surrounding communities could expand based on employment and support service opportunities. This would depend on how access between each community and the Ambler Road is handled. Additional development (changed land uses) along the Dalton Highway, such as highway support services like gas stations and restaurants, may occur. Some Native allotments and other private lands located near the selected alternative may be more likely to develop and could be developed commercially (e.g., new fly-in lodge).

The Ambler Road, if developed, could result in increased access to and travel to and within nearby areas and an increase in mineral exploration such as from South32. Subsequent mining activity along alternative road routes but outside the District may be induced by the promise of improved access to claims or just by the ability to take commercial deliveries of supplies along the road. Under Alternatives A and B, there are mining claims in the valleys north of the alignment in the southern Brooks Range. Under Alternative C, there are mining claim clusters near the Zane Hills and Ray Mountains and at Hogatza. There are also clusters of mining occurrences and prospects near Hughes. The BLM notes that there are subbituminous coal occurrences along this alternative in the Rampart Field.

Special Designation Lands. The Alternative C alignment is located relatively close to several existing ACECs and RNAs, as shown in Volume 4, Map 3-26. The Spooky Valley RNA and existing Hogatza River ACEC have greater likelihood of indirect effects than others, because these are areas that have mining claims that would be relatively easy to extend a road into under Alternative C. RNAs are withdrawn from all forms of appropriation and would need to be modified to allow any other entity the land rights necessary to build a road. Indirect effects to special designation lands are not anticipated under Alternatives A and B.

3.4.2 Transportation and Access*

Affected Environment

The study area for direct effects is limited to where proposed routes cross the existing transportation facilities; however, indirect effects may extend beyond the vicinity of a project alternative because community residents may travel long distances for subsistence purposes (see Appendix L regarding where residents travel for subsistence purposes). The study area for indirect effects extends from the District to its connection to a Southcentral Alaska port (anticipated to be the Port of Alaska in Anchorage) to account for material hauling effects. Volume 4, Map 3-27, shows existing transportation facilities near the project alternatives. Volume 4, Map 3-28, shows the regional transportation system that could be affected. Appendix F, Table 7, summarizes community-based transportation facilities.

Study area communities have limited road networks. Local roads are unpaved, with the longest road segments typically being those that access airports and landfills. Most residents do not use standard vehicles for local transportation needs. Instead, they depend on snowmobiles and other OHVs, together with boats for river travel. As a result of the limited roads, air travel is a primary mode of transportation between communities in the study area. Most communities have DOT&PF-owned airports with scheduled air service, which varies in frequency. In addition, the study area has several backcountry landing strips, which travelers use on an as-needed basis. These landing strips mostly support recreation, hunting, and mining activity.

Inter-community roads in the region are limited. The Dalton Highway is the eastern boundary of the project area and connects Alaska's North Slope to Fairbanks. It is a low-volume public highway with gravel and paved portions. AADT ranges from 300 to 400 vehicles per day, depending on the segment. For the Dalton Highway over 4 years (2013 to 2016), DOT&PF recorded 24 crashes (average 6 per year), 2 of them fatal crashes, and 6 of them serious-injury crashes (DOT&PF 2019). Several communities have year-round or seasonal access to the Dalton Highway, which connects to the Elliott Highway and the state

road system. Tanana Road/Tofty Road connects Tanana, Manley Hot Springs, and Minto to the Dalton Highway. For 1 or 2 months per year, a winter road connects Bettles and Evansville to the Dalton Highway, which connects to Fairbanks. However, winter road construction depends on specific conditions, such as sufficiently cold temperatures, adequate snow cover, thick river ice, and low wind (Spindler 2016). Residents also use winter only inter-community trails such as the Shungnak-Kobuk trail, which NAB maintains (NAB 2010).

During summer and fall, residents use boats on rivers and lakes and OHVs over land in the study area. See also Section 3.2.5, Water Resources, for discussion of navigable waters. In winter and spring, residents travel via snowmobile as snow conditions allow. Residents primarily use snowmobiles, OHVs, and boats for subsistence, local travel, and recreation purposes. During summer, commercial barge service on the Kobuk River brings fuel and freight from Kotzebue to Ambler, Shungnak, and Kobuk. Hughes does not have consistent barge service due to shallow river waters (Hughes Traditional Council 2013).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to the existing transportation system. Air travel would continue to be a primary mode of transportation between communities in the study area and to bring supplies from Alaska's road network to study area communities. Continuation of established small-scale mining development and ore exportation would likely generate similar air traffic and Dalton Highway traffic levels as today. Potential increased development activities, expansion of existing mines, and exploration and development of new mining prospects may increase air traffic and Dalton Highway traffic levels. As described in Appendix H (Section 2.3.3), there is also potential for the continued lack of surface access to the District to reduce future interests in mineral exploration and associated air traffic. Reductions in mining activities within the District could result in proportional decreases in air traffic but would maintain current Dalton Highway traffic levels.

Impacts Common to All Action Alternatives

Under all action alternatives, the proposed project would result in the development of an access road to mineral and natural resources and would include associated support facilities including: airstrips, maintenance stations with fueling for maintenance equipment and communications towers, and other facilities to support the construction, operation, and maintenance of the road, although the number of each component would vary by alternative. Alternative C has more facilities (except material sites) than the other 2 alternatives. See Appendix C, Table 1, for a summary of project components by alternative.

Transportation currently occurs in the area for subsistence, recreation, and inter-village travel. Road construction would increase vehicle and aviation traffic in the region and rail traffic between Fairbanks and south coast ports. Construction and reclamation would involve using heavy equipment and vehicles to transport personnel, fuel, and supplies during construction activities. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

All action alternatives would require construction and use of winter construction access trails to mobilize equipment, materials, and personnel to proposed construction camps, facilitate development of material sites, and support bridge construction. The winter construction access trails are generally expected to provide full corridor access for around 3 to 4 months per year, depending on weather conditions. Annual construction of the winter construction access trails and mobilization of equipment and supplies would

result in increased traffic on the Dalton, Elliott, and Steese highways during winter months between the Ambler Road and Fairbanks. The increased traffic may require additional maintenance along the highways. Traffic volumes during construction and use of the winter construction access trails are expected to be similar to those listed in Appendix H, Table 2-6, for Phase 1 activities.

Development of the road and mines would lead to increased traffic on the existing surface transportation network, especially on the Dalton Highway; see Appendix H, Table 2-6, for traffic projections during the proposed phases of road development. All action alternatives are expected to have the same traffic volume. Phases 1 and 2 would have less impact than Phase 3 because they have lower traffic volumes. The highest traffic volumes occur in Phase 3, so much of the analysis in this section focuses on Phase 3. Traffic would be a mix of ore concentrate trucks and other vehicles, such as those supporting road maintenance or supply/fuel delivery. Fuel and other hazardous materials transported on the road would create a potential for hazardous material spills (see Section 3.2.3, Hazardous Waste, for more information). Additional traffic may occur on the road to support emergency response efforts. See Section 3.3.1, Vegetation and Wetlands, for information about the potential for wildfires in the area. Upon closure of the Ambler Road, traffic on the Dalton Highway related to the District would be limited to trips associated with monitoring activity, reducing overall traffic on the segment south of the intersection.

While the proposed road is primarily intended for industrial access, AIDEA has suggested communities be allowed to use the road for certain uses, such as commercial delivery of fuel and goods. Public use would be allowed at designated crossings, which may restrict or cause out-of-direction travel for local travelers compared to current conditions. General public access to the ends of the road would be restricted by means of a staffed, gated facility at each end of the proposed road. Preventing unauthorized traffic and implementing access control could minimize vehicle conflicts and crashes. AIDEA would develop a communications plan and safety protocols to reduce vehicle crashes. AIDEA has created a subsistence working group, termed the Subsistence Advisory Group, which is charged with identifying crossing locations that could include winter trails or designated RS2477 routes (or potentially other locations) used for subsistence travel. The Subsistence Advisory Group began meeting in January 2022; as of the last meeting (June 15, 2023), the Subsistence Advisory Group has not documented locations of subsistence travel routes intersecting the proposed road. AIDEA has proposed several design features to reduce trespass on the road, including installing a staffed gate near the Dalton Highway intersection. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, summarizes these measures, which are expected to be effective at the road entry point; however, some trespass may occur, particularly by those intersecting the road in the backcountry. Federal statute and regulations provide that BLM and NPS determine the scope of allowable access through the terms and conditions of any ROW authorizations they may issue; AIDEA would have no independent discretion or permit authority if issued a ROW. All action alternatives would have potential for fuel spills, traffic crashes, and similar impacts as a result of new traffic.

After reclamation, AIDEA's security monitoring of the corridor would end and segments of the road corridor may be inviting to those on snowmobiles and possibly to users of OHVs in summer as a linear corridor. However, the removal of much of the road embankment and of all bridges and culverts would be expected to constrain use to relatively short segments, because of limiting topography and water, and mostly to winter use. Segments could become parts of permanent trails based on repeated use.

All action alternatives involve bridge and culvert construction for river crossings. These structures may limit a river's ability to be used for water-borne transportation. However, USCG permits would be required for waters determined navigable based on current or past commercial use, which can range from historical Native and mining use with small craft to tourist rafting trips to modern barge operations. Additionally, special condition number 24 of the USACE CWA Section 404 permit, which the BLM has

adopted as proposed mitigation measures (see Appendix N, Section 3.5), requires that the road "not interfere with the public's right to free navigation on all navigable waters of the U.S." (USACE 2020). While the types of impacts are similar among alternatives, Alternative C would cross the Kobuk and Koyukuk rivers in areas more commonly used by barges or other large boats while Alternatives A and B would cross rivers used more commonly by smaller craft. All alternatives need to consider potential use of Alyeska Pipeline Service Company (APSC) boats on the Koyukuk River in response to a spill from TAPS impacting the river (APSC 2014). Phase 1 would have a greater impact as the initial culverts would be installed during this phase. Design features include adequate clearance on bridges where barge service and boat use occur to reduce impacts in accordance with bridge permitting that would be effective in maintaining access (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Any infrastructure proposed below ordinary high water (e.g., bridge piers, stream gauges) on state-owned submerged lands would require authorization from ADNR Division of Mining, Land and Water. The road closure and reclamation process would result in removal of bridge abutments and the cutting of bridge piers below the streambed, ultimately restoring full free-flow and removing any navigation obstacle.

On December 18, 2020, the USCG issued 2 letters to AIDEA regarding proposed bridge construction along Alternative A, and thus assumed generally applicable to Alternative B. The first letter granted advanced approval for the Koyokuk River bridge under 33 CFR 115.70 and states that a USCG bridge permit is not required for the proposed bridge. The second letter states that the remaining proposed crossings "are not tidally influenced and are not currently used for substantial commercial navigation," so the USCG declines jurisdiction and USCG bridge permits are not required for the proposed bridges. Both letters were issued under the condition that bridges would maintain safe passage of small craft currently using the river at typical base flows; during consultation with the USCG prior to issuance of the letters, AIDEA submitted a revised Table 2 – Section F to the SF299 USCG Bridge Permit Application that committed to providing a minimum of 12 feet of vertical clearance for the eleven large bridges along Alternative A (Koyukuk, Wild, John, Malamute Fork Alatna, Alatna, Kobuk, Reed, Mauneluk, Kogoluktuk, and Shungnak rivers and Beaver Creek). The proposed 12-foot vertical clearance would be sufficient to safely pass APSC spill response boats, which require a vertical clearance of 10.5 feet. No USCG determination has been completed for Alternative C.

AIDEA estimates an additional 1 to 2 flights per week to each maintenance station (Davis 2019b). Alternative C would be associated with more flights because it has more maintenance stations. Construction of the road would result in a temporary increase in regional air traffic during construction to support crew changes and transportation of supplies. Construction related air traffic would likely originate in Fairbanks or Anchorage. After road and airstrip closure and removal, aviation activities would consist of an occasional overflight for monitoring activities. See Appendix H for air traffic estimates.

Alternatives A and B Impacts

The impacts under Alternatives A and B would be similar to those impacts common to all action alternatives. The intersection of Alternatives A and B with the Dalton Highway would occur at MP 161.

Alternative C Impacts

Alternative C would connect to the Dalton Highway at MP 59.5. Alternative C would have more potential for fuel spills, traffic crashes, and similar impacts because it is the longest of the action alternatives and traverses mountainous terrain. Traffic would spend more time on Alternative C than on the other alignments. However, if the routes are evaluated as the distance between the District and Fairbanks, Alternative C would be similar to other alternatives—17 miles longer than Alternative A and 3 miles longer than Alternative B. Alternative C would cross the Koyukuk and Kobuk rivers. The Kobuk River

crossing is a concern as it could affect barge service to Kobuk, so adequate bridge clearance would need to be provided to avoid impacts to that service.

Combined Phasing Option

The combined phasing option would result in heavier construction traffic along the Steese, Elliott, and Dalton highways from Fairbanks to the Ambler Road corridor due to the shortened overall duration of construction, assumed to be 3 years or less for this option compared to 4 years or less for phased construction. Construction traffic would also impact road and rail routes beyond Fairbanks, such as routes to Anchorage, Seward, Whittier, Port MacKenzie, or Valdez, to mobilize equipment and materials to the Ambler Road. Overall, the reduced construction duration would result in average construction traffic volumes increasing by 33 percent compared to the phased construction options; approximately the same number of trips would be required, but they would be condensed from a 4-year duration to a 3-year duration.

The combined phasing option would likely result in heavy, concentrated construction traffic along the Steese, Elliott, and Dalton highways from Fairbanks to the Ambler Road corridor during winter months when the winter construction access trails would provide surface access along the road alignment over the course of road construction. Under the phased construction options, completion of the Phase 1 pioneer road would generally provide access to the entire road alignment from the Dalton Highway during Phase 2 construction (years 3 and 4) and allow construction-related traffic from Fairbanks to be spread out over the calendar year. By contrast, under the combined phasing option, full surface access along the road alignment wouldn't be available until completion of the road, thus placing heavier reliance on the winter construction access trails to support construction activities through year 3.

A single 1-season mobilization along the winter road may be sufficient to stage a bulk of the needed equipment and supplies at identified construction camps; however, fuel, perishable items, and construction materials would need to be regularly resupplied to construction camps to maintain construction efforts through all 3 years. Delivering and storing sufficient fuel quantities during the initial mobilization to support 3 years of construction is not likely feasible. Likewise, construction materials, specifically bridge girders and culverts, can have substantial fabrication lead times, especially for the quantity that would be required to construct the road; as a result, materials would have to be mobilized and staged periodically during construction. Air transport is not a viable option to transport the quantities of fuel needed or to move heavy materials like bridge girders. As a result, construction materials, fuel, and supplies would need to be staged in Fairbanks or elsewhere along Alaska's road network to be transported to construction camps and bridge crossings during winter months.

While the Phase 1 pioneer road would not likely support ore extraction and transport, it is reasonable to expect that mining companies would want to use the pioneer road to transport equipment and supplies to support exploration efforts. Under the combined phasing option, mining companies would also be limited to the seasonal period that the winter construction access trails are in use to coordinate transporting equipment and supplies, potentially further increasing traffic on the Steese, Elliott, and Dalton highways during winter months.

The combined phasing option would likely also result in increased air traffic along the road corridor during construction compared to phased road construction. Whereas the Phase 1 pioneer road would generally facilitate surface access to the road corridor after year 2 of construction, the combined phasing option would be significantly more reliant on air transportation for delivering supplies, material, equipment, and moving personnel to and from and along the corridor during times when the winter construction access trails are not operational until the Ambler Road is completed.

Mining, Access, and Other Indirect and Cumulative Impacts

Mine Development and Roads

Mine development would change transportation use in the region, increasing road, rail, aviation, and port activity due to the need to transport ore concentrate to market and people and supplies to and from the mines (see Appendix H, Section 2.1.4, Reasonably Foreseeable Mine Development Scenario). The magnitude, duration, and spatial extent of the indirect and cumulative impacts largely depend on the location and extent of mining activity that occurs as a result of the proposed project. Development of the mines would lead to increased traffic (60 to 75 percent increase at its peak during the operational period of the mines) on the proposed road as well as on the existing road system between the Dalton Highway turnoff and the Alaska Railroad yard in Fairbanks (see Appendix H, Table 2-5). This traffic increase would occur for 161 miles of the Dalton Highway under Alternatives A and B and 59.5 miles under Alternative C, plus portions of the Elliott and Steese highways en route to Fairbanks (identical for all alternatives). Alternatives A, B, and C would entail 452, 469, and 472 miles of trucking distance, respectively, from the District (Ambler River road terminus) to Fairbanks. The concentrate trucking is likely to occur 24 hours a day, while other traffic is more likely to occur between 7:00 a.m. and 7:00 p.m. Locations near the road are likely to experience more road noise (see Section 3.3.6, Acoustical Environment (Noise)). An ore-trailer staging area near the intersection of the proposed road and the Dalton Highway would be used to break double-trailer rigs from the mines into single trailer rigs for transport to the rail yard. This area would likely have a higher than normal volume of turning traffic that could conflict with other traffic.

The increase in traffic would likely result in an increased number of crashes over the project's 50-year life span and increase the amount of maintenance needed on these roads, particularly for Alternatives A and B, under which trucks would use 100 miles more of the Dalton Highway than under Alternative C. Assuming road maintenance costs are proportional to increases in traffic, maintenance costs on the existing road system segments used by Ambler mining–related vehicles would increase by approximately 60 to 75 percent at the peak of traffic. Proposed mine traffic from liquified natural gas trailers travelling from the North Slope to Fairbanks would further increase the volumes of heavy truck traffic on the Dalton, Elliott, and Steese highways to Fairbanks; these trucking operations are expected to begin in 2024-2025 with a 20-year contract term (IGU 2023). Additional maintenance is likely to be funded by DOT&PF and may impact DOT&PF's ability to fund other projects and would further strain already constrained road budgets. The existing traffic volumes are below the capacity of the 2-lane road, so the added trips would have a minor impact on the Dalton and Elliott highways.

Increased truck traffic would likely have a greater impact on the roads between the Elliott Highway turnoff and the Alaska Railroad yard, such as the Steese Expressway. In general, the roads nearer to Fairbanks population center already are busier. Proposed mine traffic related with the Manh Choh Mine would further increase volumes of heavy truck traffic on the portion of the Steese Highway between the Elliott Highway and Fairbanks. Trucking operations associated with the mine are expected to begin in 2024, last 4 to 5 years, and result in an average of 60 trips per day, 7 days a week (Kinross Gold 2023). The project would result in greater truck traffic in the existing mix of passenger vehicles and trucks. No improvements to these roads are anticipated.

Further oil development also would likely spur Dalton Highway projects. Small-scale mining likely would still occur in the project area. For miners who do not have access, or cannot afford to use the Ambler mining road given potential stipulations based on other approved admittances on the roadway, parallel transportation routes may be developed to access small-scale mines. These roads are likely to be constructed to a lower standard than the proposed road. Small-scale mining would also increase traffic on

the existing transportation system as part of mine/road construction and operation. The impacts on the existing transportation system are expected to be within the capacity of the system.

DOT&PF is proposing several reconstruction projects along the Dalton Highway (from MP 0 to 414) to ensure design standards are met and improve conditions related to safety, efficiency, performance, longevity, and maintenance costs as discussed in Appendix H, Section 1.3.2, Past and Present Actions. Construction of the Ambler Road may overlap with proposed DOT&PF construction projects, which would result in increased traffic volumes along the Dalton Highway and potential impacts on Dalton Highway reconstruction schedule due to increased traffic maintenance requirements. After completion of the proposed DOT&PF projects, the reconstructed segments can be expected to better support and improve safety for Ambler Road–related traffic and other mining related traffic. However, increased traffic associated with the Ambler Road would likely negatively impact the anticipated performance, longevity, and maintenance costs associated with the DOT&PF reconstruction efforts.

Closure of the Red Dog Mine could result in reclamation of the DMTS (road), removing a road from the overall inventory of roads in the region. However, it is not a public road; is not connected to the road network; and would have little impact on transportation.

Ambler Road Construction

Mine construction equipment would be transported from Fairbanks to the mine sites. These loads may be oversize and/or overweight. Transportation of these loads would require permits and would temporarily impact traffic. These loads would generally be restricted from traveling in the Fairbanks area during heavy commuter traffic times to reduce the impact to highway users. These loads may also have escort trucks to provide warnings to oncoming traffic and improve safety. Once on the Ambler Road, these loads would have no impact on the existing transportation system. If other construction projects occurred simultaneously, then the existing transportation system could be affected, causing short-term congestion. These impacts are also anticipated during road closure and reclamation.

The existing transportation systems are anticipated to be able to accommodate this additional demand without causing traffic congestion. Additional road maintenance on the existing transportation system would be required, however, due to increased industrial traffic.

Spur Roads

AIDEA has proposed that communities would be allowed to use the road for commercial deliveries. Development of these spur roads would depend on the community's proximity to the proposed road and ability to find construction funding. All action alternatives have the potential for spur roads to Ambler, Kobuk, and Shungnak. Alternative C would join the Kobuk road system less than 2 miles from town. Kobuk is less than 15 miles from Alternatives A and B. Kobuk already has a road to the Bornite Mine and a road to the Dahl Creek Landing Strip, ensuring that the proposed road would provide additional surface access to Kobuk. Shungnak is approximately 5 miles from Alternative C and 16 miles from Alternatives A and B. There is boat access and trail access between Kobuk and Shungnak so any commercial deliveries access to Kobuk would likely benefit Shungnak as well. Ambler is approximately 25 miles from all action alternatives. Ambler would be connected to the western terminus of the Ambler Road via the Ambler River and is connected to Shugnak by winter trail and river. Given the distance, it is possible but less likely that the proposed road would result in a change in transporting goods to Ambler.

Alternatives A and B have more potential for a spur road to Bettles and Evansville (approximately 8 miles). However, as a winter road between these communities and the Dalton Highway already is built most winters, the development of a new spur road is hard to estimate. Furthermore, an initial alignment

examined by DOT&PF early on that passed near Bettles and Evansville was dismissed from consideration due to community objections of the road going near or through those communities. Alternative C is more likely to result in a spur road to Hughes (3 miles).

Development of other connector roads is less certain. The cost of constructing and maintaining these spur roads is likely to be high given the challenging soil conditions and other factors. Some communities farther away from the alignments, such as Allakaket or Alatna, may find it cost prohibitive to construct a connection to the proposed access road. It is more likely that additional winter trails would be developed.

If a spur road or even 4-wheeler trail is built or good winter trail is available, freight delivery to the villages would change, lowering the cost of goods. This would have a positive benefit. These spur roads could also change how fuel is delivered to the villages. Rather than relying on a delivery by fuel barge or plane, which typically only occurs once or twice a year, a village could switch to, or supplement with, fuel transported by truck. Whether truck delivery would result in substantial cost-saving depends on many factors.

Spur roads supporting delivery of commercial goods and services within the region would add traffic to the Steese, Elliott, and Dalton highways between the Ambler Road and Fairbanks. The traffic volumes associated with commercial deliveries are expected to be small.

The development of mines is also expected to result in the development of additional roads in the District surrounding the mines. These roads would not have public access and would not be expected to impact the existing transportation system.

Rail

Transportation of construction materials and ore concentrate would increase rail traffic between Fairbanks and Southcentral Alaska. Refer to rail traffic projections in Appendix H, Table 2-7. It is believed that the Alaska Railroad can accommodate this additional rail traffic. The increased rail traffic would result in minimal increase in traffic delay at at-grade rail crossings. It is also expected to have a minimal impact on the accident frequency at existing rail crossings. Assuming the Port of Alaska in Anchorage were the final destination, the rail distance would be approximately 356 miles. Other rail-accessible ports are within about 50 to 100 miles of Anchorage.

Marine

Mining activity would likely result in approximately 22 ships per year departing from 1 or more Southcentral ports; refer to vessel projections in Appendix H, Table 2-8. At the port, full and empty concentrate containers would have to be stockpiled and loaded and unloaded from trains and then emptied into the ship. This activity would result in increased activity at the port, which would likely generate noise and increase light emission in the area surrounding the port. Depending which port mining companies select, there may be additional impacts associated with the project as the port may need additional land-side infrastructure or additional cleared space to support concentrate shipping. Ambler Metals (formerly Trilogy) indicated the Port of Alaska in Anchorage as the port to which concentrate would be transported (Trilogy 2018a). It is anticipated that the Port of Alaska in Anchorage can accommodate the additional marine activity because it receives ships only 2 days per week, leaving the other days available to handle increased demand.

Aviation

The airstrips developed for the road project and for the mines would be for project and private use and not intended for public use. They are unlikely to impact aviation in the area. Construction and operation of

the mines would result in an increase in regional air traffic. Most of this air traffic is assumed to originate in Fairbanks or Anchorage. See Appendix H, Table 2-4 for an estimate of air traffic for the 4 main mine sites. During construction of the access road, AIDEA has indicated aircraft operation levels would depend on the selected contractor's plans for construction, but there would be at least weekly flights (1 to 2 flights per week) to each construction camp (Davis 2019). During roadway operations, AIDEA indicated an estimated 1 to 2 flights per week per maintenance station (Davis 2019). The number of flights would be higher for Alternative C than the other action alternatives because it has more maintenance stations.

Additional mining activity would likely result in the improvement to the Dahl Creek Airport as well as the development or expansion of additional airstrips. Workers likely would have a 2-week-on, 1-week-off schedule and would likely be flown from the area to local villages or Fairbanks. There would be an increase in regional air traffic especially between Fairbanks International Airport and airstrips in the District. The existing facilities at Fairbanks International Airport are likely to be able to accommodate this increase in traffic. This increase in air traffic would have negative impacts (such as noise) on communities located on the flight path. There may be additional aviation-related impacts depending on how workers from local villages are transported to the mines. Flights from the mines to each village could result in increased air traffic. The ability for the existing airport in each village to support the flight depends on the size of plane used. Alternatively, local mine workers may take a commercial flight from their village to Fairbanks, where they would change planes for a flight to the mine. In this circumstance, there would be minimal change in air traffic to the village, but there would be slightly more demand for commercial flights, which may influence cost and availability, making it more difficult or more expensive for villagers to travel, especially on short notice.

Transporting goods and personnel to the mine may increase the need for commercial air service. Private sector air carriers may expand their operations to accommodate the additional demand. Adversely, if freight deliveries were made using the proposed road instead of by air cargo, air carriers may experience a loss of revenue. This may impact the cost and/or availability of passenger and cargo air travel. The airstrips are likely to be available to support emergency situations such as a wildfire or search and rescue efforts.

Operations and Unauthorized Use

Potential for trespass by unauthorized users would be low beyond the staffed gate near the Dalton Highway, as road alternatives intersect few existing roads and would most likely result from use of OHVs on regional trails. Alternative C would intersect the existing 15-mile road between the Bornite and Kobuk, providing opportunity for full-size vehicles to access the road. As Bornite is less than 3 miles from Alternatives A and B, it is reasonable to assume existing trails would be improved to road standards to likewise connect Alternatives A and B to the road to Kobuk, again providing potential unauthorized access by full-size vehicles. Future road connections from mining developments would also facilitate potential trespass, though primary users of these roads would be mining personnel expected to stay in compliance with operational rules of the road. Unauthorized use of the road could present a safety hazard for authorized road users. As AIDEA is proposing strict operational controls over the road and supporting airstrips, and AIDEA proposes to have full communication coverage along the road, the likelihood of trespass by unauthorized users to significantly impact road or air operations is low.

Public and Non-Industrial Access

Potential future lawful use of the road by the public for non-industrial purposes, as described in Appendix H, Section 2.2.2, Public and Non-Industrial Access, would result in increased traffic volumes (compared to no public access) but may be lower than previous industrial-use traffic volumes assuming public access is obtained after closure of mines or significant reductions in mining activity. However, because the road

would provide direct access to GAAR, which is currently not accessible by road, public access could result in significant traffic increases due to tourists who wish to visit GAAR via the road. Commercial vehicle use bringing tourists to GAAR is a reasonable foreseeable use of the road. Public use, including potential commercial use, would add traffic to the Dalton Highway, Elliott Highway, and a portion of the Steese Highway, increasing the potential for crashes between public vehicles and industrial vehicles on the Dalton, Elliott, and Steese highways and increasing maintenance demands on those highways and the Ambler Road. Recreational use of the road may result in establishment of trails, airstrips, and campsites connected to or near the Ambler Road (BLM 2007). Public access along the Ambler Road would likely result in increased recreational watercraft use on rivers crossed by the road, such as rafts, canoes, and small motorboats. Commercial activities, such as rafting trips along the Kobuk River through the GAAR Preserve to Kobuk or Shungnak could result in significant increases of watercraft use.

Driver Shortages

The proposed project is also likely to worsen the shortage of drivers with commercial driver's licenses (CDLs). This may have a negative impact on other industries as they may be unable to employ enough drivers or need to hire drivers from outside Alaska (Friedman 2018). Due to the employment opportunity, it is likely that more people would pursue obtaining a CDL, which would reduce the shortage. After road closure and reclamation, there would be more drivers with CDLs who could work in other industries. See Section 3.4.5, Socioeconomics and Communities, for more information regarding employment and training.

Communication Lines

Potential development of OTZ Telephone Cooperative communication towers within the vicinity of the Ambler Road may improve communication between vehicles and aircraft on the Ambler Road, thereby improving operations and safety along the project corridor.

Ambler Road Closure

After the road closure, traffic volumes on the Dalton Highway and other existing roads would be reduced but is unlikely to return to current traffic volumes. Aviation, rail, and marine activity would also be reduced but unlikely to return to existing activity levels. Freight delivery to local villages would no longer be available, which would impact the cost of living in these communities. During the 50-year life span of the project, increase activity is likely occur due to other development in the area and to population increases.

3.4.3 Recreation and Tourism*

Affected Environment

Recreation and tourism in the project area includes road-based activity along the Dalton Highway, fly-in/backcountry trips along the southern Brooks Range and in the Ray Mountains, and fishing and hunting along the broad lowland river corridors. Volume 4, Map 3-29, illustrates common float trips, lodge areas, and Dalton Highway recreation features.

The BLM manages land covered by the Utility Corridor RMP (BLM 1991a) primarily as a transportation and utility corridor for TAPS and the Dalton Highway. However, many people drive the highway for recreation, and the BLM also manages for this use. The *Recreation Area Management Plan: Dalton Highway* (BLM 1991b) designates the "inner corridor" as an SRMA (see Volume 4, Map 3-26), where recreation is a top management concern. Primary activities in the inner corridor are sightseeing, overnight lodging and camping at developed sites, interpretive services, and fishing. Developed recreation facilities such as campgrounds and visitor contact stations occur at designated development nodes. The BLM

manages the "outer corridor" for primitive/traditional recreation opportunities, where primary activities are hunting, fishing, backpacking, and snowmobiling. The BLM prohibits recreational OHVs or snowmobiles within 5 miles of the highway ROW, in deference to state law. West of the corridor, recreation occurs, but the *Resource Management Plan and Record of Decision for the Central Yukon Planning Area* (BLM 1986) does not emphasize its management. Similarly, the state and NWRs have land management plans that allow, but do not strongly emphasize, management for recreation (see Section 3.4.1, Land Ownership, Use, Management, and Special Designations).

Recreation and tourism traffic is an important component of Dalton Highway traffic. The BLM operates 2 seasonal visitor contact stations on the Dalton Highway. The Yukon River Crossing station has recorded an average of 7,481 visitors per summer season (2004 to 2018; Egger 2019). The Arctic Interagency Visitor Center at Coldfoot has averaged 8,467 visitors per summer season (2004 to 2018; Egger 2019). Winter activity has been growing, particularly tours for aurora viewing. AADT near the Yukon River approaches 300 vehicles per day (HDR 2018), which is low by 2-lane highway standards. Monthly AADT in summer is 400 to 450 vehicles per day. Truck traffic accounts for approximately two-thirds of the total, with the percentage of trucks increasing with latitude as recreation and tourism traffic turns back and trucks continue to Deadhorse. Using this two-thirds estimate, approximately 150 vehicles per day in summer are standard vehicles, including local resident traffic, oil industry traffic in light vehicles, tour vans, and independent recreational visitors. Traffic counts group recreational motorhomes with trucks. For some independent drivers, contending with trucks on a narrow, and often gravel, road adds challenges to the drive and could detract from the recreational experience.

In 2023, the BLM authorized 25 tour businesses to use facilities in the highway corridor. These typically are van tours from Fairbanks to the Arctic Circle and other destinations. The tour companies annually report numbers of clients at various stops. BLM records show strongly increasing numbers overall from 2010 to 2023. The Arctic Circle Wayside, which represents setting foot in the Arctic for tourists, is the most popular site, with 22,082 visitors in 2022, based on reports from the tour companies..

A backcountry area not accessible by road and without permanent recreational trails is located west of the Dalton Highway corridor. GAAR, other parks and wildlife refuges, the Brooks Range, and the area of mostly undeveloped lands south of the mountains make up a mostly intact natural landscape that is the primary attraction for people seeking backpacking, river floating, and fishing experiences. See also Project Area under Section 3.1 (Introduction) regarding consideration of the full landscape. Visitation numbers in the backcountry mostly are not monitored by the land managing agencies. The NPS as a participating agency for this Supplemental EIS indicated that GAAR as a whole gets 400 to 1,000 individual visitors per year, almost all of them in the snow-free season and most of them travelling by river. The NPS EEA indicates that Walker Lake, near the project alternatives, received average known visitation of 85 in 2013–2017, that permits are not required for park entry, so the numbers are likely undercounted, and that the length of time each visitor spends is among the highest in the national parks system (8 to 10 days; NPS 2019a). The level of use outside the GAAR boundary to the south is expected to be of similar or greater magnitude, as float trips that start in the park continue south outside the park and because rivers and communities provide additional means of access by powerboat, snowmobile, and aircraft for local residents and visitors.

Whether guided or independent, virtually all visitors use tourist services—small-aircraft bush pilots, guides (e.g., backpacking, rafting, fishing, hunting, photography, birding, and dog mushing guides), outfitters/rentals, and/or lodgings. Visits occur mostly in summer, but also on snow (with fewer visitors), including dog sled tours, aurora borealis viewing, flightseeing, and lodging. Tourism in the area is based on the natural environment—scenic mountains and river valleys in natural condition, and wildlife and fish for which such areas are habitat. Wilderness characteristics are an important driver of Alaska visitation

(Colt and Fay 2017). As indicated in Section 3.4.5, Socioeconomics and Communities, wildlife viewing and hunting contribute economically to the state.

A typical trip uses scheduled flights to Bettles and charter aircraft on "tundra tires," floats, or sometimes skis to land on gravel bars, lakes, or flat rivers. Recreationists backpack and/or paddle for multi-day trips on their own or with guides. Such trips are in keeping with "solitude" and "primitive and unconfined recreation" values, highlighted in GAAR management (note that ANILCA also allowed for a road through the District in the GAAR Preserve). The undeveloped state- and BLM-managed land south of GAAR also provides for these values, and many float trips traverse these lands; however, the state and BLM do not manage land outside the park to retain wilderness values. Nonetheless, as evidenced by comments on the Draft EIS, the area is perceived by many as wild or "wilderness." Appendix F, Table 8, summarizes common river floating routes. Recreationists can also take floating/fishing trips from the Dalton Highway, where it crosses rivers that flow west through Kanuti NWR. Many other streams in the project area may also be used for floating or powerboat access. See also Sections 3.2.5, Water Resources, and 3.4.2, Transportation and Access, for other discussion of navigable waters. Commenters on the Draft EIS from Tanana indicated dog mushing tours, other ecotourism, and recreational uses of the Ray Mountains and its hot springs occurs from the Tanana area and that tourism includes photography, hunting and fishing, backpacking, and river floating. Among the fly-in options are trips to remote lodges such as Iniakuk Lake Wilderness Lodge and Peace of Selby Wilderness Lodge at Narvak Lake. Each lodge has several outlying cabins on private lands in the Alatna and upper Kobuk drainages, some within GAAR. The lodges offer high-end, customized trips with airplane support for sightseeing, hiking, boating, fishing, hunting, aurora viewing, and dog mushing. The lodges' websites market the wilderness and park surroundings (Peace of Selby Wilderness Lodge 2019; Iniakuk Lake Wilderness Lodge 2019).

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any additional impacts to recreation and tourism activity or trends. Dalton Highway and air travel associated with fly-in/backcountry trips would remain the primary means of accessing the analysis area for recreation and tourism. Continuation of mining development and ore exportation would likely generate similar air traffic and Dalton Highway traffic levels as today. As described in Appendix H (Section 2.3.3), there is also potential for the continued lack of surface access to the District to reduce future interests in mineral exploration, resulting in a potential decrease in traffic, visual and noise impacts to areas managed for primitive recreation opportunities.

Impacts Common to All Action Alternatives

In general, Volume 4, Map 3-29, illustrates the locations of recreational features and routes and proximity to the alternatives and driving routes anticipated. The map helps define the extent and likelihood of potential impacts to recreation.

Creating a road for 200 to 300 miles across an otherwise mostly undeveloped area would be perceived by many recreationists and tourists as an impact to the nature-based tourism resource and businesses in the region. A road in the backcountry would be a visual and audible interruption in the road corridor through the natural environment. Publicity about the road could cause some potential visitors to go elsewhere, with an economic impact to pilots, guides, and lodge operators who depend on those visitors. It is likely a new normal would be established once the road was in place, and new visitors with different expectations would replace those displaced, but the experience currently available in parts of the study area, and the reputation of the region as a whole would be changed.

Impacts would occur along the road corridor where people enjoying a remote, natural experience in the backcountry would see the proposed road or hear its traffic or other associated sounds. This is most likely to occur in river corridors popular for boating when boaters approach a bridge or fish, hike, hunt, or camp near a bridge. It is likely the road and any associated facilities located near these rivers would effectively create a zone people would not use for these activities. For people intending a recreational trip away from the routines of home, whether home is in a city or a village in the project area, the road would be an engineered structure in a natural environment, and traffic, dust, and new aircraft overflights would intrude visually and audibly on the experience. For people who have been in the backcountry for multiple days, potentially with several more days ahead of them, crossing a road in the middle of the trip would be a disruption and a considerable change in the recreation and tourism environment. These impacts would occur both for fly-in paddlers floating out of GAAR and for residents and visitors using motorized boats and travelling the rivers. Bridge piers are expected to be designed to minimize hazards to navigation. See Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA; see also Appendix N for potential BLM mitigation measures. See also discussion of navigable waters in Section 3.2.5, Water Resources. Physical passage would likely not be a substantial issue, but the structures and road traffic would materially change the experience. Most people in powerboats likely would be less sensitive to the presence of the road, particularly to the sounds of the road, but would be affected by seeing the road. These types of impacts also would affect guides and lodge owners, potentially reducing demand for their trips. Mobile guides may be prompted to shift to other areas, which could crowd those other areas or result in greater competition for guiding permits. For lodges located near a road alternative, the road could require changing the business model.

Although recreational use of the road is not a proposed use (see Chapter 2), some people may try to hike or hitch a ride out to the Dalton Highway from a bridge crossing. Recreational hunters or anglers, including local residents and visitors, similarly may try to use (i.e., trespass on) portions of the road to access fish and game.

Similar to effects on river users, impacts could occur for anybody traveling cross country and coming across the road. Cross-country travel would be relatively rare in summer and more likely during winter. The winter construction access trail would provide further opportunity for access along the road in the winter months and may inadvertently encourage recreational use of the road by providing a viable travel option. Lodge owners; lodge guests; and other landowners visiting their lands, cabins, or fish camps located near the road likely would feel a change in their customary environment. Also, because shooting from or across a road is against State of Alaska law, the road would create a narrow corridor off-limits to taking game. In all cases, it is likely that people would continue to use the rivers, public and private lands, and lodges for recreation and tourism, hunting and fishing, with shifts by independent travelers to other, more remote streams (e.g., rivers in the Arctic NWR) and areas likely; however, there is not sufficient data to know whether this would be discernable from normal variations in use.

After road closure and reclamation, the land would revert to management under then-current land-use plans of the underlying land owners. The natural landscape could be largely restored, without road activity, noise, and dust. Visual evidence of the road would be expected to remain for decades and potentially permanently in many locations (see Section 3.3.4, Mammals), but if other development had not occurred near the corridor by that time, nature-based recreation and tourism could return. Lodges and guides could reorient somewhat more to clients interested in wilderness characteristics. River users would no longer see bridges or hear traffic during their float trips. Restrictions on cross-country travel would be lifted, and portions of the corridor may attract use particularly by snowmobile but possibly also by summer vehicles, although removal of the road embankment, bridges, and culverts would likely preclude long-distance use of the corridor. With a 50-year life span, it is unknown how land-use planning or nearby developments might change this scenario.

Alternatives A and B Impacts

Alternatives A and B would cross 6 of the 7 common float trips listed in Appendix F, Table 8 (the Selawik River excepted), and several others such as the Reed River. This table, along with Volume 4, Map 3-29, help to illustrate the likelihood, magnitude, and extent of impacts. Of the 6 common float routes crossed, 1 (the Kobuk) is crossed where it is designated a WSR. Four others are designated WSR where they occur within GAAR but are not designated WSR where these alternatives would cross. However, virtually all parties that float the WSRs float several days beyond GAAR to a community or backcountry area suitable for pickup by small plane. The scenery changes as the rivers leave the mountains and become flatter, wider, and more winding, but the remote characteristics remain. Crossings by road would affect the sense of solitude and remoteness currently experienced.

Alternatives A and B would terminate at a material site adjacent to the Ambler River. Alternative A would cross the designated Kobuk WSR 3.8 river miles south of Walker Lake (2.7 straight-line miles), while Alternative B would cross the Kobuk WSR 26 river miles southwest of Walker Lake (14.6 straight miles) and would include an airstrip and maintenance station near the river. Under Alternative A, the road and dust plumes from traffic on the road would be visible and traffic likely would be heard under some conditions near Walker Lake, a primary access point for visitors to this part of GAAR. The maintenance station in the Preserve under Alternative B would be a node of activity adjacent to the WSR that would generate new aircraft take-off and landing operations and substantial starting and stopping of truck traffic. This visible and audible activity would impact the recreation experience. The alternatives would be identical near Iniakuk and Narvak lakes, where lodges are located.

Approximately 1 mile of the shared Alternatives A and B alignment, roughly centered on MP 1, would be approximately 0.75 mile upstream of and at a similar elevation as the existing access road for Chapman Lake. Chapman Lake is located west of the Dalton Highway, which is listed in BLM recreation documents as a wildlife viewing site for highway travelers. In addition, a material site and Ambler Road maintenance station are proposed near Ambler Road MP 0.6 and overlapping the road to Chapman Lake. The material site would be easily visible from a lake overlook at a distance of 0.5 mile. The AIDEA gatehouse also is likely to be in this area. Traffic on the new road is likely to be audible from the lake, and dust likely would be visible. Vehicles on the Ambler Road may be visible from some vantage points depending on tree cover, which is variable but sparse in this area. The gatehouse would be expected to have continual traffic sounds audible and overhead lights and buildings visible from the lake area, decreasing the attractiveness of the location for wildlife viewing. The material site could temporarily or permanently eliminate public road access to the lake overlook.

Impacts to recreation near Chapman Lake largely would cease upon road closure and reclamation, but the reclaimed road corridor could attract vehicle use for a short distance. The corridor would cross a medium sized drainage approximately 4 miles from the Dalton Highway and several small drainages in between. With all culverts removed, these would be impediments to vehicle use, but some recreational access could occur, most of it likely in winter.

Alternative C Impacts

Alternative C would avoid any recreational impact associated with GAAR. It would terminate adjacent to the Ambler River. It would cross the Kobuk River downstream of Kobuk, where most river floaters end their trips, so would avoid most impacts to recreationists floating out of GAAR. Alternative C would not cross the other common river float trips (see Appendix F, Table 8) and would therefore avoid those impacts. Alternative C would cross the Kobuk River (outside its WSR designation) and cross and parallel the Hogatza and Koyukuk rivers, all used by boaters for sport fishing, hunting, and access to fish camps and other private property used in part for recreation. Impacts as described for all action alternatives

would occur and likely would affect more river users overall, although some would be passing under the road solely for transportation rather than recreation. The road could conflict with recreational uses of the Ray Mountains, particularly those accessing the mountains from the Yukon River/Tanana River. The valleys are narrow, and some areas may not have space for safe winter travel between slopes with avalanche potential, the river, and the road. Noise, vehicle lights, and the presence of the road would alter the experience. Recreational use at any time of year is thought to be relatively low. Overall, Alternative C impacts on recreational experiences would occur in less sensitive areas than those impacted by Alternatives A and B.

Upon road closure and reclamation the road corridor near the Dalton Highway could attract vehicle use on the reclaimed road for a short distance. The corridor would cross the Ray River and associated wetlands within approximately 5 miles from the Dalton Highway. With all culverts and bridges removed, waterways would be impediments to vehicle use, but some recreational access could still occur, most of it likely in winter. In winter, the corridor could provide desirable recreational access through timbered areas beyond the Ray River to the eastern Ray Mountains.

Combined Phasing Option

Under the combined phasing option (which applies to all action alternatives), construction would occur in 2 to 3 years. Noise, vehicle lights, and the presence of the road would alter users' recreational experiences year-round due to the constant construction activity. However, ultimately, construction impacts such as increased levels of noise and presence of workers would be more short-lived and limited in scope due to the elimination of the construction of the pioneer road. The expedited timeline would certainly require winter construction and greater reliance on winter access trails (ice roads and ice bridges) than the phased construction options. As cross-country recreational travel would be more likely during winter, and as winter recreational activity has been growing, these winter access construction methods could increase the ability of and incentive for recreationists to utilize the road. This could pose an issue and result in increased incidence of trespass, as the road is not intended to be open for recreational access.

Mining, Access, and Other Indirect and Cumulative Impacts

The EIS reflects the results of past actions, namely the creation of conservation system units, which have attracted attention for recreation and tourism, and the Dalton Highway, which has created an avenue for public access and sightseeing. The EIS describes the impacts of the Ambler Road, particularly the introduction of bridges across rivers used for boating that are otherwise undeveloped and provide a natural recreational environment. Past actions have resulted in a growth trend in recreation and tourism on the Dalton Highway, in the Brooks Range, and at a lower level along other major rivers. The primary future actions that would contribute to effects to recreation are the openings of multiple mines in the District. Development of mines near the west end of the road would have the same kinds of impact to backcountry recreational use as noted in Chapter 3 for the road, but in a broader and less linear fashion. The District would be active for 50 years and altered by open, terraced mining pits, tailing ponds, and spur roads. Monitoring activity by aircraft and road vehicles could occur in perpetuity, making large parts of the District generally unattractive for backcountry recreation. The Ambler River is anticipated to be bridged for access to the Smucker Mine, further impacting recreational river trips in the area.

Mine development, like road development, would alter current backcountry recreational use patterns. Comments on the Draft EIS indicated concern that the road and mines would impact a growing tourism industry in the area and would affect the future of that industry. Economists and tourism specialists note an "Alaska difference" provided by the attraction of large intact ecosystems in the state (Colt and Fay 2017). "The global supply of wilderness is decreasing while the demand for Alaska nature-based tourism is growing," and over time it is likely that Alaska will be able to extract ever greater economic value from

tourism related to such landscapes (Colt et al. 2002 and Dugan et al. 2009, as cited in Colt and Fay 2017). The effect of the road cumulatively with the mines and other potential transportation and industrial developments would diminish the area available for this type of tourism growth in Northcentral Alaska. As an example, if reasonably foreseeable oil development occurs on the north side of the Brooks Range in the Arctic NWR as proposed, that development could result in impacts to several common nature-based float trips in the eastern Brooks Range, and Ambler Road Alternatives A and B would affect most of the common nature-based float trips in the central Brooks Range. Together with the past effects of TAPS and the Dalton Highway on floatable rivers in the TAPS corridor, the number of Brooks Range river trips possible without passing under a bridge or seeing a road, pipeline, or other development would be substantially reduced.

However, it is likely that Alaskans will seek ways to access the Ambler Road, and management decisions regarding public and non-industrial access may result in expanded recreation access. Local residents will likely use portions of the road for subsistence purposes or, potentially, for recreation, when traveling on snowmachine, OHV, or foot. The road may also be used to facilitate boat access for fishers and boaters, potentially creating more access opportunities at river crossings. Additionally, after the useful commercial life of Ambler Road, it may be converted to a public road. Such a conversion would provide recreational access to more remote interior areas, expand river access, and designate an additional ROW for recreational driving and/or the use of OHVs and snowmachines.

For all alternatives, the mining companies are assumed to seek permits to create an ore-trailer staging area near the intersection of the Ambler Road with the Dalton Highway within the BLM Special Recreation Management Area. This would be where double-trailer rigs would be broken into single trailer rigs for hauling on the public roads. This is assumed to be an area large enough to stage multiple trucks and trailers and to allow multiple double trailers to pull through without backing. It likely would include ancillary facilities such as 1 or more heated buildings, a generator, fuel supply, and outdoor lights. During peak production years, this trailer assembly area likely would have literally continuous idling and movement of diesel trucks 24 hours a day, and continual sounds of backup bells. Such a staging area is implicit in the concept of using double trailers on the Ambler Road and single trailers on the Dalton Highway. Near MP 161 (Alternatives A and B), such a facility could conflict with use of Chapman Lake for wildlife viewing, depending on final placement of the staging area. Near MP 59.5 (Alternative C), such a staging area would not conflict with known recreation uses.

Tourists/recreationists on the Dalton Highway would be affected by increased truck traffic associated with the mines. Large trucks can be intimidating to some recreational drivers, and difficult to pass. With multiple mines operating, traffic on the Dalton Highway could be more than 50 percent greater than current levels. Dust on the Dalton Highway would be harder to avoid. Noise would be more continuous along the roadsides. Waysides, toilets, and other facilities shared by recreationists and others would be more crowded and likely would be inadequate for the increased traffic. Without improved or additional waysides, toilets, and other facilities, recreationists likely would feel the experience deteriorated from current conditions. The BLM manages rest areas along the Dalton Highway and may incur additional costs to maintain these facilities. Dalton Highway traffic impacts from Livengood to the Alternative A/B intersection would occur over 161 miles. Such impacts to the Alternative C intersection would occur over 59.5 miles. Cumulative impacts of the road project added to other projects would occur principally because the road would induce development of the mines. The road and the mines together would substantially alter the recreation environment along the southern Brooks Range, with somewhat greater effect under Alternatives A and B than under Alternative C.

3.4.4 Visual Resources*

Affected Environment

The proposed road corridors are mostly undeveloped lands with a natural appearance and a visual variety of planar, rounded, and blocky topographic forms; vegetation textures; water; and colors. All public lands have scenic value, but areas with the most variety and harmonious composition have the greatest value (BLM 2018c). In some locations, there is evidence of human activity (e.g., cabins, communities). The most prominent feature of the built environment is TAPS, which includes swaths cut through the forest for the Dalton Highway and the pipeline, and the highway and reflective pipe themselves.

Key viewing locations typically are points or corridors where people are likely to be, particularly in areas where there is an expectation for a pleasant or natural view, including

- river corridors and lakes used for recreational float trips, particularly the Alatna, John, North Fork/Middle Fork Koyukuk, Kobuk, and Wild rivers and Walker and Nutuvukti lakes;
- The Dalton Highway Scenic Byway, particularly pullouts and overlooks along the highway;
- communities, where people are present most often; and
- lodges, cabins, and seasonal hunting/fishing camps, where the same people may visit repeatedly.

The BLM manages visual resources under a Visual Resource Management (VRM) system. The BLM manages the Dalton Highway "inner corridor" per Class IV VRM objectives, where a high level of change in landscape character is allowed and results of management activities may dominate the view (BLM 1989, 1991a, 1991b). The BLM manages lands associated with the "outer corridor" as Class III, where management activities may attract attention but should not dominate the view (BLM 1989, 1991a). The BLM addresses lands farther west in the existing Central Yukon management area as follows: "Areas of outstanding scenic value in the Ray Mountains would be managed where possible to retain existing character of the landscape. Other areas would be managed to lessen impacts from other activities" (BLM 1986).

In the project area, the BLM (2018c) has prepared a Visual Resource Inventory (VRI) for lands in the Central Yukon management area. The BLM categorizes lands into 4 VRI classes, which are separate from VRM classes. VRI classes represent the relative value of the visual resource: Classes I and II are most valued, Class III is of moderate value, and Class IV is the least valued. The VRI process involves a scenic quality evaluation (visual appeal); a sensitivity level analysis based on the number of people expected to be in an area, their purposes, and the nearby land management; and a delineation of distance zones from a travel corridor or viewpoint. The final VRI class (I–IV) summarizes these elements in a single classification. Volume 4, Map 3-30, shows BLM VRI classes for the study area. See VRI (BLM 2018c), incorporated here by reference, for detail.

The NPS completed a VRI for GAAR related to the proposed project (Meyer and Sullivan 2016). Visual values of NWR lands are similar to the NPS- and BLM-managed lands, but this analysis does not address them because no alternative would cross NWR lands. The State of Alaska does not specifically manage its lands for scenic values.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative largely would retain current trends in which visual changes are small and incremental, mostly in the vicinity of other current development. Within the District, mineral exploration may continue at low levels and could result in some development in new areas, including buildings, airstrips, cat tracks, continued mineral exploration via aircraft, and potentially roads, and these would change the local visual environment with contrasting lines, forms, colors, and textures.

Impacts Common to All Action Alternatives

All action alternatives would affect the visual environment. Appendix F, Tables 9 and 10, illustrate how much of each alternative would lie within VRI and VRM areas shown in Volume 4, Map 3-30. The tables and map together help to illustrate the likelihood, magnitude, and extent of impacts. Impacts occur when a harmonious composition of visual elements and visual variety is disrupted. The proposed project would introduce a linear engineered element with a contrasting light-colored gravel surface into a primarily natural environment of darker colored trees and tundra. The visual texture of the road would appear harder and smoother than most surrounding land cover. Consequently, the road would be immediately visible when trees or terrain were not blocking it, and from higher vantage points. The line of the road, as well as motion, dust plumes, reflection, and lights from traffic on the road, would draw the eye of people scanning the landscape. As a curving line following the contours of the land, the road would not necessarily be visually unpleasant, but it would be distinct, and different from everything around it. Major project bridges would be large engineered structures that would coincide in many cases with river travel corridors where people concentrate, but in most cases river travelers would quickly pass the structures. Boaters likely would not see other parts of the road, although material sites or water access points are near some bridges and may be visible.

Other project elements, such as the dozens of material sites, several permanent maintenance camps with 3,000-foot runways, and multiple communications sites with buildings and communications towers, also would place contrasting forms, lines, textures, and colors into the mostly natural setting. Communications towers likely would be gray galvanized metal structures 100 to 150 feet tall, much taller than any local trees. Buildings are likely to be boxy, metal-sided structures built for utility over aesthetics, creating contrasting forms. Potential mitigation measures outlined in Appendix N (Section 3.4.4, Visual Resources) include color specifications for siding and roofing to reduce the contrast of structures, but it is likely the surfaces would remain reflective and therefore highly visible over distance when the view angle and sun angle converged. For users of the road, who would be looking out on the landscape and expecting a road to be part of the view, the driving experience overall is likely to be perceived as highly scenic and pleasing.

NPS completed a viewshed analysis for the portions of Alternatives A and B that would cross GAAR (Meyer and Sullivan 2016; see in particular Summary of Findings and Conclusions), basing some of the work on a visual analysis NPS performed in conjunction with AIDEA (DOWL 2014b), both incorporated here by reference. The AIDEA effort included figures with simulation of the road appearance from 10 key observation points within GAAR. These simulations may be considered reasonable representations of the type of visual change that would occur under any alternative, including at locations outside GAAR, at similar distances and vantage points. Appendix A, Figures 3-6 and 3-7, provides example simulations. Areas near the Dalton Highway are classified VRI Class II, indicating they are inventoried as having high visual values, and these lands are the backdrop for the Scenic Byway designation. However, the BLM manages these lands to allow for visual changes because the corridor is an industrial utility corridor for

TAPS (VRM Classes III and IV). Appendix F, Table 9 shows how much of each alternative would be within the VRM classes. The new road, its security gate, a material site, and maintenance station buildings and equipment would be in these areas and would dominate the view for people near them. This would be expected and allowed under VRM Class IV. For VRM Class III, "dominating the view" generally is not allowed. Most viewers in these areas would not be near the new road, however. They would be drivers on the Dalton Highway, and the Ambler Road intersection is likely to pass in a moment and not dominate the view.

It is somewhat a contradiction that visual assessment often focuses on the number of people affected while at the same time, lands may be managed precisely for low numbers of people. In general, the number of people living in, visiting, or otherwise passing through the study area is considered low in comparison to urban areas or the entrance areas of the most-visited national parks in the state and nation such as Denali, Yosemite, and Yellowstone. However, many visitors and residents in the area west of the Dalton Highway have an expectation of seeing few other people and few human developments. The visual effects may be of less importance when considered in light of the relatively small number of people affected, but may be of greater importance considering the expectation of those in the area for natural views and the importance of GAAR for management as a natural setting.

The impacts of the road would be of long duration, likely permanent despite closure and reclamation measures, and would include strong contrasts when seen from relatively close range or higher vantage points. Reclamation activities would create their own temporary visual impacts, when the road corridor, camps, and airstrip locations would look like construction zones, with highly contrasting exposed earth, mud, construction debris, and active equipment. Once final contours and revegetation were established, the appearance would have less contrast in color and texture but would be likely to retain different vegetation types and, therefore, different color and texture than the natural surroundings for decades.

Alternative A Impacts

Alternative A, like Alternative B, would traverse the southern foothills of the Brooks Range, an area generally of high visual variety (BLM VRI Class II). ANILCA provided for passage via road through GAAR. Alternative A would cross the National Preserve for 26 miles, roughly paralleling the Wilderness boundary within approximately 1 mile for 16 miles, and it would cross the Kobuk WSR. Management of GAAR lands is the most sensitive to visual changes of any in the project area, particularly the designated Wilderness and WSR. The alignment would be within approximately 0.25-mile of the WSR for approximately 2 miles. People floating the Kobuk WSR and other rivers downstream of a "wild and scenic" designation, such as the potentially affected common river float routes following the non-designated Wild and Reed rivers would encounter visually contrasting bridges (see Section 3.4.3, Recreation and Tourism, and Appendix A, Figure 3-6). The area of Alternative A around MP 1 would be in an area visually connected with Chapman Lake, where there may be viewers valuing the mostly natural setting for whom the new facilities would dominate the view (see Section 3.4.3, Recreation and Tourism).

Alternative B Impacts

Alternative B, like Alternative A, would traverse the southern foothills of the Brooks Range, an area generally of high visual variety (VRI Class II). Alternative B would cross the National Preserve for 18 miles at a distance of 8 miles or more from the Wilderness boundary, effectively out of sight, which would create less impact than Alternative A but would cross the WSR and affect its scenic characteristics. Alternative B would be within approximately 0.25-mile of the WSR for approximately 0.7 mile. While ANILCA provided for passage through GAAR, management of these lands is more sensitive to visual changes than most other lands in the project area. As with Alternative A, users floating the Kobuk WSR and other rivers downstream of a "wild and scenic" designation, such as the potentially affected common

river float routes following the non-designated Wild and Reed rivers, would encounter visually contrasting bridges (see Section 3.4.3, Recreation and Tourism, and Appendix A, Figure 3-6). The area around MP 1 of Alternative B would be in an area visually connected with Chapman Lake (see Section 3.4.3, Recreation and Tourism), where there may be viewers valuing the mostly natural setting for whom the new facilities would dominate the view.

Alternative C Impacts

Alternative C would traverse mountains, rolling hills, and broad river flats, not unlike that shown in Appendix A, Figure 3-7. The visual variety of these areas is particularly high in the Ray Mountains (VRI Class II), but certain flat areas (e.g., 50 miles of road north and east of Hogatza) provide less visual interest (Classes III and IV). Land management along this alignment is not highly sensitive to visual changes. The road would pass approximately 1.3 miles west of Kobuk. Dust plumes likely would be visible west of town. Traffic, including reflections and headlights coming off the hills to the north, would increase and would occur 24 hours per day. The Kobuk River bridge and road would be readily visible by anybody traveling downriver by boat or snowmobile, a common route. At Hughes, the road and Koyukuk River bridge would be similarly visible by anybody traveling upriver or to the northwest (e.g., up Hughes Creek). Overall, Alternative C visual impacts are larger in area due to its longer length, but of less severity due to lower sensitivity of users and less land management sensitivity.

Combined Phasing Option

Visual impacts would come from the same construction sources; however, because of the non-phased construction, more of the equipment, dust, and traffic would be present. This is counteracted by the overall duration of construction being shortened and therefore, construction visual impacts being lessened. Overall, the combined phasing option would have the same visual impacts as the individual options.

Mining, Access, and Other Indirect and Cumulative Impacts

Past actions have resulted in the visual environment described in the Affected Environment, with gradual incursion over more than 100 years of visible cut trails and expanded communities. Construction of TAPS and the Dalton Highway resulted in major visual changes in the 1970s. In 1980, creation of conservation system units protected and to a certain extent promoted the natural visual environment and, at the GAAR Preserve, allowed for a road to the District. The impacts of the proposed road would continue a trend of lines across the project area.

The mining scenario described in Appendix H would result in 4 new mines with associated roads and airstrips in the mountains north of Kobuk and south of GAAR. Several open pits mines that each could be 0.75 mile across and with tailings areas up to 1.5 miles long and 0.75 mile wide, along with traffic dust, lights, and buildings to house several hundred to more than 1,000 workers would change the visual environment of the area, introducing the engineered, stair-stepped mining pits and unnatural and contrasting forms (buildings, embankments), lines (roads, vertical mill towers, communications towers), and colors. This area is used primarily by local residents and some river floaters (e.g., Ambler River and Wild River) and is seen by people traveling by aircraft for transportation or tourism. The numbers of travelers who would see the mine-related development is not high, but many of those who would see them likely would be sensitive to the changes.

The visual impacts of the proposed road would be important by themselves, regardless of alternative. Combined with past impacts (particularly the Dalton Highway/TAPS corridor) and the reasonably foreseeable mining development, impacts in the project area would be greater. The impacts would be

similar among the alternatives except that Alternative A would affect more sensitive GAAR and WSR lands along the proposed road. Alternatives B and C, and particularly C, would affect less sensitive areas. However, Alternative C, because of its length, would affect a larger area overall. Given the requested ROW time frame of 50 years, it is reasonable to assume that once the road is constructed, local residents within the general area as well as other Alaska residents will seek ways to access the road both lawfully and unlawfully. This would be unlikely to have any additional impacts to visual resources in the project area.

3.4.5 Socioeconomics and Communities*

Affected Environment

The socioeconomics study area focuses primarily on the Yukon-Koyukuk Census Area (YKCA) and the NAB. Particular emphasis is placed on describing socioeconomic conditions in the communities within 50 miles of the proposed road that are not connected to the statewide road system year-round. The proposed project could potentially result in changes to resident and commodity transportation patterns and costs in these communities. The YKCA communities within approximately 50 miles include Bettles, Evansville, Allakaket, Alatna, Huslia, Hughes, Tanana, and Rampart, while the NAB communities within approximately 50 miles include Kobuk, Shungnak, and Ambler. Residents in the Nome and Kusilvak Census Areas and North Slope Borough could also experience effects to subsistence resulting from impacts to caribou (see Section 3.4.7, Subsistence Uses and Resources). Volume 4, Map 3-31, depicts these geographic areas and the locations of the potentially affected communities. Appendix F, Table 21, lists the communities that could be affected and provides population and demographic data.

Economic Conditions

This analysis focuses on NAB and YKCA economies because that is where the primary socioeconomic impacts are anticipated. Many of the communities in these locales have "mixed" economies in which households rely on cash income and the harvest of subsistence resources. Cash-paying jobs tend to be temporary or seasonal in rural Alaska, so cash incomes tend to be small and insecure (ADF&G n.d.). Transfer payments, including the Permanent Fund Dividend, unemployment benefits, retirement benefits, and Medicaid payments, account for a much larger share of household income (Goldsmith 2010). In 2021, transfer payments in the NAB and the YKCA accounted for 39 percent and 41 percent of personal income in the region, respectively, compared to 21 percent statewide (BEA 2023). Due to the low availability of jobs, together with the high cost of food in local grocery stores, subsistence is essential to many of these residents' diets. Rural households use cash to purchase fuel oil, electricity, and family goods, such as clothing. They also use cash to purchase equipment used in subsistence hunting, fishing, and gathering, such as guns and ammunition, fishing nets, boats, OHVs and snowmobiles (including gas and oil), and rain gear. This use of cash to invest in subsistence food production is an essential component of many household economies (Wolfe and Walker 1987; ADF&G n.d.).

Employment. Appendix F, Table 11, presents a snapshot of the current employment by sector at the NAB and YKCA based on data from the Alaska Department of Labor and Workforce Development. The most recent available annual average employment data is for the year 2022. While the COVID-19 pandemic that occurred in 2020 resulted in significant job losses throughout the state, it should be noted that job losses in the NAB and YKCA were relatively minor compared to other regions in the state. Between 2019 and 2020, the NAB lost just 11 jobs (a less than 1 percent change) while the YKCA region lost 149 jobs (6 percent). Other regions like the Denali Borough and regions in Southeast Alaska with larger service sectors, particularly in leisure and hospitality, experienced the highest job losses due to the pandemic (Fried 2021).

In 2022, the average annual employment in the NAB totaled 2,730 jobs (see Appendix F, Table 11). The majority of the jobs were in the private sector, accounting for 64 percent of the total jobs in the region; while government sector jobs accounted for 37 percent (ADOLWD 2023). Activities related to government, mining, health care, transportation services, and leisure and hospitality contribute to the region's economy. The Red Dog Mine, which is the largest zinc and lead mine in the world, supports 370 direct year-round jobs and provides more than 25 percent of the wage and salary payroll in the NAB. The largest employers in the NAB are TeckAlaska (owner and operator of the Red Dog Mine), Maniilaq Association (a nonprofit organization that provides health, Tribal and social services to residents of the region), Kikiktagruk Inupiat Corporation (the Alaska Native Village Corporation in Kotzebue), and the Northwest Arctic Borough School District (NAB 2023).

Employment in the YKCA totaled 2,220 jobs in 2022 (see Appendix F, Table 11). More than half of the total jobs in the region were in the local government sector (65 percent of the jobs); total government sector jobs, including state and federal jobs, accounted for 71 percent of total jobs. There were only 640 jobs in the private sector (29 percent of total jobs). Tanana Chiefs Conference (TCC), a nonprofit corporation that provides social and health services to Alaska Natives, is the largest private employer in the region. TAPS passes through the center of the census area, with 3 pump stations between Livengood and Coldfoot (Shanks 2013). Work associated with TAPS accounts for many of the highest-paying private-sector jobs.

The recreation and tourism sector is a smaller employer of local residents, but the scenery, rivers, parklands, and opportunity to see and recreate in the arctic are a draw of the study area. Animals in Alaska have economic value for viewing and hunting or fishing. For example, a 2014 ADF&G study indicated that statewide Alaskans and visitors spent $3.4 billion ($4.62 billion in 2023 dollars) directly on wildlife viewing and hunting trips in 2011, resulting in a total of $4.1 billion ($5.57 billion in 2023 dollars) in economic activity in the state in that year (ECONorthwest et al. 2014). Visitors also support Dalton Highway tours, flightseeing, backcountry guiding, and fishing and hunting trips out of Fairbanks and study area communities such as Bettles.

Appendix F, Table 13, shows the unemployment rates in the NAB, YKCA, and Alaska (statewide) from 2019 to 2022. Unemployment in 2022 was generally high in the study area: 9 percent in both the NAB and YKCA compared to the 4 percent statewide unemployment rate. Unemployment rates in the NAB and YKCA were significantly higher in prior years, with double-digit rates in 2019, 2020, and 2021, while the statewide unemployment rate was highest in 2020 (COVID-19 year) at 8.3 percent (ADOLWD 2023). Note that unemployment data likely underestimate the number of people who would like to work, particularly in more remote communities, because the unemployment rate includes only people who are actively seeking work. Several of the study area communities are off the road system, making commuting to a job in another town or city impractical. Consequently, some people may cease to actively search for work (Robinson 2009).

Cost of Living. Air travel is the most commonly used form of transportation for access to communities in the project area. Reliance on air travel is costly for the communities, which are not connected to the statewide road system, and this is reflected in the high prices for goods and services. A recent study of grocery costs in 16 Alaska communities conducted by the University of Alaska Fairbanks' Cooperative Extension Service reports that the highest costs are in areas where most food is flown in. For example, in Kotzebue, groceries are more than double the cost for the same items in Fairbanks and Anchorage (Fried 2018). The provision of public infrastructure and services in rural Alaska is expensive. For example, the cost to construct public buildings in rural Alaska is approximately twice as much per square foot as in Anchorage (Foster and Goldsmith 2008). The higher construction cost is due to higher freight costs (barge

and air), limited supply of specialty labor (mechanical, electrical), permafrost and other challenging foundation conditions, weather delays, remote logistics, and high fuel costs.

Cost of Energy. Heating fuel is a major expenditure in the study area communities, as shown in Appendix F, Table 12. In 2022, the prices per gallon for gasoline and fuel oil were higher in the study area communities (ranging from $6 to $11) compared to the average prices across all the communities included in the Alaska fuel price survey ($5.03 per gallon of heating fuel and $5.31 per gallon of gasoline). The *Anchorage Daily News* reported that heating fuel in Noatak, north of Kotzebue, briefly hit $16 a gallon (Teel 2022). The high cost of energy in these areas are a particular economic burden on local households given the relatively high unemployment and poverty rates among YKCA and NAB residents.

Study area communities use diesel fuel to generate all electricity produced and consumed in each community. The cost of generating electricity in rural areas is considerably higher than in urban areas of the state, as stand-alone diesel generators not tied into the regional grid generate the electricity. Delivery of fuel for power generation, heating, and transportation is seasonal and limited by sea or river ice, water levels, or ice road availability. This means that communities must store large volumes of fuel oil in bulk fuel storage tank farms to meet their annual energy needs. Fuel storage requires a substantial capital infrastructure investment (Wilson et al. 2008). Additionally, the lack of economies of scale leads to costly electricity per unit produced (Fay et al. 2012). The state subsidizes rural electric utilities customers through the Power Cost Equalization (PCE) program, which lowers residential electricity rates in participating communities. Appendix F, Table 12, shows the PCE subsidy rates for FY 2022. During the COVID-19 pandemic, the NAB, using CARES Act funds, supported households in their region with $500 of relief for a household's choice of electric, water and sewer, or stove oil relief (NWAB 2020).

Community Services

Health Care. Health clinics offering primary care are located in all study area communities. However, the staff, equipment, and other resources of many of these clinics are limited, meaning that trauma and serious illness cases must be sent to an outside hospital, usually by airplane or helicopter. Helicopter medevacs can cost $100,000 or more, and fixed-wing aircraft medevacs exceed $22,000 (Schoenfeld 2013; Alaska Federal Health Care Partnership 2016).

Law Enforcement. Law enforcement in the study area is primarily the responsibility of Alaska State Troopers, provided by a central headquarters with area posts in Fairbanks, Coldfoot, and Kotzebue. The logistical issues created by distance between posts and communities, together with erratic weather conditions and limited weather stations, create challenges for troopers largely dependent on aircraft to conduct their work. Some communities, including Allakaket and Alatna, have no local law enforcement officer; therefore, there is little ability for officers to provide a prompt response in the event of an emergency.

Solid Waste Disposal. Non-combustible solid waste must be disposed of in approved facilities using appropriate procedures. To ensure that waste generated can be accepted at landfills, ADEC recommends that project proponents coordinate with local landfills and the ADEC Solid Waste Department early on in the project development. In most of the study area, solid waste is disposed of in local landfills operated by local governments. The exception is Bettles, which uses the landfill at Evansville. All landfills in the study area are categorized as Class III (i.e., a municipal landfill that accepts less than 5 tons of solid waste per day and is not connected by road to a larger landfill or is 50 miles by road from a larger landfill; 18 AAC 60.300(c)(3)). Landfills at Evansville, Huslia, Rampart, Ambler, Kobuk, and Shungnak backhaul some household hazardous materials and recyclables by barge, small boat, airplane, or truck to a larger community for final disposal (ADEC 2019b). However, the feasibility of most backhaul programs varies annually, seasonally, and daily depending on transportation costs, local government revenue, river depths,

and staff experience (Zender Environmental Health and Research Group 2015). Landfills at Alatna, Allakaket, and Hughes currently have no backhaul capability (ADEC 2019b). The Bornite Mine Camp, located 12 miles north of Kobuk, has a permitted landfill. The BLM would not allow the burial of garbage within the lands it manages in the project area.

Public Health

A health impact assessment has been completed (NewFields 2019) that describes current human health conditions for communities within 50 miles of the proposed road and project alternatives. Potentially affected communities are located in the Interior Public Health Region (YKCA) and Northern Public Health Region (NAB). The overall illness and mortality indicators for the area are generally consistent with the overall trends observed for all Alaska Natives. Illness is dominated by communicable diseases, dental disease, injury, and poisoning. Musculoskeletal diseases are a leading cause of outpatient visits. Cancer incidence rates have increased substantially over the last 50 years and are associated with underlying rates of smoking, alcohol usage, and obesity.

The 3 leading causes of mortality for all Alaska Natives are cancer, heart disease, and unintentional injury. The Northern Public Health Region has higher cardiovascular and unintentional injury mortality rates than the Interior Public Health Region. Chronic obstructive pulmonary disease (COPD) mortality rates have increased considerably and are consistent with high smoking rates. Alaska Native males had substantially higher mortality rates for cancer, heart disease, unintentional injury, suicide, COPD, and alcohol abuse than Alaska Native females. Alaska Native females had substantially higher rates of mortality due to cerebrovascular disease and chronic liver disease than Alaska Native males. Alaska Native infant mortality rates have decreased substantially since the 1980s. Life expectancy for Alaska Natives has been increasing since the 1980s and is now 70.7 years.

NOA is present in multiple geographic areas within the Interior Public Health Region.

Environmental Consequences

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any changes to socioeconomic conditions in the study area communities and none of the potential economic benefits and adverse impacts of road construction and operations would occur. The No Action Alternative would likely maintain the current baseline trends in the region.

Impacts Common to All Action Alternatives

Employment and Income. The number of jobs that would be directly and indirectly supported by road construction and operation under each alternative was estimated for this section using IMPLAN, an input-output model. Estimates of the percentages of jobs that would be filled by residents of the NAB/YKCA region were obtained from the University of Alaska (UA 2019). The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

While employment and income opportunities would vary under each action alternative and would be different during road construction or operations, all action alternatives would provide some increased job opportunities for residents. However, jobs may be temporary. A majority of the study area communities have high levels of unemployment and low-income with high costs of living. AIDEA has stated that the proposed access road could alleviate some high costs through potential commercial access for affected communities (see Appendix H, Section 2.2.1, Commercial Access Scenario).

Under all action alternatives, most of the direct, on-site construction jobs would be in the heavy civil construction trade, including heavy equipment operators, site engineers, construction managers, and construction laborers. State-level data from the ADOLWD indicates that approximately 82 percent of construction laborers in Alaska live in the state (Kreiger et al. 2023). While firms based in Anchorage would likely receive most of the Alaska-based construction contracts, it is expected that workers employed by these firms would come from all regions of the state. As a state agency, AIDEA cannot offer a hiring preference to residents of the NAB/YKCA. However, there are several construction workers currently working in the region that would be qualified to fill project construction jobs. In 2022 for example, there were 64 jobs in the NAB and 42 jobs in the YKCA in the heavy construction and specialty trade contractors sector (ADOLWD 2019). Also, many residents are available for immediate employment, as there were approximately 250 unemployment insurance claimants in the NAB and 186 in the YKCA in 2022 (ADOLWD 2023). Many of these unemployed individuals may have the requisite skills for construction jobs or could be trained for construction jobs at project worksites.

Construction of the proposed road would initiate subsequent rounds of income creation, spending, and re-spending. Third-party contractors, vendors, and manufacturers receiving payment for goods or services required by the project would, in turn, be able to pay others who support their businesses. Also, people directly and indirectly employed to construct or maintain the road would generate jobs and income as they purchase consumer goods and services to meet household needs (also termed “multiplier effects”). Impact Analysis for Planning (IMPLAN), an input-output model, was used to estimate the multiplier effects of the project’s construction and operation on the statewide economy. These multiplier effects take into account both the sector-based interactions that exist in the economy and the leakages in the form of purchases of goods and services from outside Alaska.

Annual O&M expenditures would provide ongoing employment once construction was completed. An estimated 20 percent of the jobs directly supported by operation of the proposed road would be filled by NAB/YKCA residents (UA 2019).

Road construction could also potentially generate economic benefits for ANCSA corporations, such as Doyon Limited and NANA. For example, portions of the road alignments cross 10 to 12 miles of land that Doyon Limited owns, including ownership of the surface and subsurface (Alternatives A and B) or subsurface only (Alternative C). Furthermore, there are proposed project material sites located on land for which Doyon Limited owns the subsurface estate. Elsewhere, Doyon Limited manages 40 sand, gravel, and rock sources in 34 villages within the Doyon region to generate revenue (Doyon Limited 2019). Road construction would require approximately 23.6 million cubic yards of material for a total estimated cost of $160.2 million ($205 million in 2023 dollars), which includes labor and the material expense. Of this total amount, under a 2015 approximation of the current Alternative A, approximately $28.6 million (or $36.6 million in 2023 dollars) in revenues could accrue to Alaska Native entities (Cardno 2015).

Public comments on the Draft EIS indicated concern from multiple communities about the communities and regional residents absorbing adverse impacts without seeing substantial benefits, and concern about benefits accruing only to some communities and not to all those that may be adversely impacted. See also Appendix H, Section 3.5.5, Socioeconomics and Communities.

Road reclamation would be a large construction-type project similar to initial road construction. Similar numbers of jobs likely would be created. However, once reclamation was complete, all employment related to the Ambler Road would end. Construction and maintenance workers in the region and from elsewhere would be no longer have jobs or income from this source.

State and Local Government Revenues. According to economic studies done for the project (UA 2019; Cardno 2015), no local government revenues are expected to be generated during road construction, operation, or reclamation. Once mining projects are operational, local governments may receive additional revenue from Payment in Lieu of Taxes (paid to the NAB) and the Village Improvement Fund, as indicated in Appendix H, Tables 3-7 and 3-8. AIDEA indicates it pays an annual dividend to the State General Fund and would continue to pay a dividend from Ambler Road revenue for the life of the project (Davis 2019a). The State of Alaska also may receive royalty payments from excavation of embankment materials and aggregate on state lands during road construction. There is insufficient information to estimate the dividend or potential material sales payments. It is therefore also difficult to determine if the State of Alaska would generate more revenues from this investment compared to other potential uses of the funds. Any payments specifically associated with the Ambler Road would cease once the road was closed.

Community Services. During construction, it is anticipated that project construction workers for the proposed road would be housed in work camps, so no increase in demand for community services and other public infrastructure is anticipated in study area communities. During road operations, people employed during O&M of the proposed road would likely commute (likely by air) from their homes and live in accommodations at the maintenance stations; therefore, they are not projected to create additional demand for public infrastructure and services in study area communities.

Rural Lifestyle. Public and non-governmental organization comments on the Draft EIS, including those from local communities, included concerns for the effects of the project on the quality of life in rural communities. Commenters expressed concern that road access into these remote areas would introduce more human activity and development that would detract from the rural lifestyle and forever change the culture and traditional practices of the Alaska Native communities. There is also concern that competition for subsistence resources would increase and subsistence resource availability would be reduced (see Section 3.4.7, Subsistence Uses and Resources), which would also affect the rural lifestyle. The potential benefits of job creation and access to goods through commercial delivery could also have a negative effect on the lifestyle of the community by building reliance on the cash economy rather than subsistence. These influences would be removed when the road was closed and reclaimed, but it is unclear whether cultural shifts that had occurred would shift back.

Public Health. Impacts to human health are somewhat similar across all action alternatives, with differences based primarily on each community's location and distance from the road. The health impact assessment conducted in 2019 provides details on the potential human health impacts related to the proposed project alternatives (NewFields 2019). Potential effects are related to socioeconomic improvements in household income and employment during active road construction and operation. Increased economic benefits may decrease the number of food-insecure households but would also change the use of traditional foods. Increases in accidental releases (e.g., fuels, hazardous materials) could affect terrestrial and aquatic resources, which would affect access to traditional foods. Potential subsistence impacts to access, quantity, and quality (real or perceived) related to road construction and operation (e.g., NOA and other dusts, noise, physical barriers, habitat fragmentation, competition for resources) could occur with resulting effects on local diets as discussed in Section 3.4.7, Subsistence Uses and Resources. Changes in diet are associated with long-term increases in non-communicable disease rates such as diabetes (NewFields 2019). Road construction and operations could increase distribution and consequent human exposure to NOA materials, which could have resultant health effects, particularly with prolonged exposure (see introductory asbestos discussion in Section 3.2.1, Geology and Soils). Asbestos air quality risks would be greater for workers building and using the road than for community members, who would not normally be close to the road. Volume 4, Map 3-2, helps to illustrate the extent of areas with NOA, although NOA gravel material could be used for construction in areas different than

its source. It is anticipated that design features (commitments) from AIDEA listed in Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, coupled with proposed mitigation measures in Appendix N would acceptably limit the public health risks from asbestos exposure to local communities, road workers, and subsistence users and others crossing or passing near the road.

Increased interaction between community members and industrial road traffic could result in serious accidents and injuries. Potential measures that could decrease impacts, including participatory monitoring and health education and promotion, are further discussed in the Health Impact Assessment (NewFields 2019:Chapter 5, Table 64), and some are included in Appendix N. The direct influences of a road on public health would be removed at the end of the project life, when the road was closed. However, to the extent the changes had become ingrained in new patterns of eating and in community culture, public health influences could persist long after the road was gone. The loss of road-related jobs and loss of access for commercial delivery of fuel and goods could combine to weaken local economies of communities, particularly those nearest to the road (named below), and change health outcomes again. However, the influences of road closure may be difficult to discern from other influences, depending on what other local, regional, national, and global changes occur during the 50-year life of the Ambler Road.

Alternative A Impacts

An estimated total of 2,990 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phase 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 750 jobs annually. Assuming 82 percent of the construction laborers are state residents, Alaskans would hold 620 of the direct jobs per year. An estimated 120 of these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region (based on a UA 2019 study).

Construction-related spending for materials and services would support an additional estimated 120 jobs throughout Alaska annually, while construction employee spending would support an additional 290 jobs annually. Overall, it is estimated that 1,160 jobs would be supported annually during project construction.

An estimated 40 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 8 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 20 jobs throughout Alaska annually, while operations employee spending would support an additional 20 jobs annually. Overall, an estimated 80 jobs would occur annually during road operations.

Potential health impacts from Alternative A are essentially the same as those discussed above for all alternatives. Alternative A and B alignments are quite similar; therefore, the health consequences are nearly identical. Kobuk, and possibly Shungnak and Ambler, would see similar potential for these health-related effects because they would be similarly situated geographically from the road under any alternative. Bettles and Evansville would be more likely to experience health-related impacts under Alternatives A and B as compared to Alternative C due to their proximity to the road alignment under those alternatives.

Alternative B Impacts

An estimated total of 3,210 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phases 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 800 jobs annually. Assuming 82 percent of the construction laborers are state residents, Alaskans would hold 660 of the direct jobs per year. Approximately 130 of

these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region.

Construction-related spending for materials and services would support an additional estimated 130 jobs throughout Alaska annually, while construction employee spending would support an additional 310 jobs annually. Overall, it is estimated that 1,240 jobs would be supported annually during project construction.

An estimated 40 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 8 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 20 jobs throughout Alaska annually, while operations employee spending would support an additional 20 jobs annually. Overall, an estimated 80 jobs would occur annually during road operations.

Potential health impacts from Alternative B are essentially the same as those discussed above for all alternatives. Alternatives A and B alignments are similar; therefore, the health consequences are nearly identical. Kobuk, and possibly Shungnak and Ambler, would have similar potential for health-related effects because they would be similarly situated geographically from the road under the action alternatives. Bettles and Evansville would be more likely to experience health-related impacts under Alternatives A and B as compared to Alternative C due to their proximity to the road alignment under those alternatives.

Alternative C Impacts

Because it is much longer, Alternative C would provide more road construction and operations jobs than Alternatives A or B. An estimated total of 5,750 jobs would be directly supported by the construction of the proposed road over the entire construction phase. If Phase 1 and 2 construction lasts 4 years, the average direct construction employment is projected to be 1,440 jobs annually. Assuming 82 percent of the construction laborers are state residents, Alaskans would hold 1,180 of the direct jobs per year. Approximately 240 of these direct jobs would be filled by NAB/YKCA residents, assuming 20 percent of the construction jobs would be filled by residents of this region.

Construction-related spending for materials and services would support an additional estimated 240 jobs throughout Alaska annually, while construction employee spending would support an additional 550 jobs annually. Overall, it is estimated that 2,230 jobs would be supported annually during project construction.

An estimated 50 jobs would be directly supported by operation of the proposed road. Of these direct jobs, 10 would be filled by NAB/YKCA residents, assuming 20 percent would be filled by residents of this region. Operations-related spending for materials and services would support an additional 30 jobs throughout Alaska annually, while operations employee spending would support an additional 20 jobs annually. Overall, an estimated 100 jobs would occur annually during road operations.

Impacts from Alternative C are identical to Alternatives A and B with the following exceptions: (1) exposure to NOA materials is likely to be less of an issue because Alternative C traverses areas identified as having less "high to known asbestos potential" (see Volume 4, Map 3-2), and (2) the community of Kobuk, and possibly Shungnak and Ambler, would see similar potentials for these health-related effects because they would be similarly situated geographically from the road under any alternative. Hughes would have closer proximity to the road and would be more likely to experience the impacts described above, while Bettles and Evansville likely would not.

Combined Phasing Option

As noted in Section 2, the combined phasing option applies to all the action alternatives and would require construction to occur in 2 phases only (with Phases 1 and 2 combined into a single phase), whereby the road would be constructed to Phase 2 standards (a year-round 1-lane road). Under this option, it is estimated that construction of the route to Phase 2 requirements would only involve mobilization of construction equipment once which shortens construction time to approximately 2 to 3 years compared to 3 to 4 years for separate construction of Phase 1 and Phase 2 roads. Under this option it is anticipated that the total workforce requirements over the entire construction phase (to fully build all the necessary infrastructure required under each of the action alternatives to Phase 2 standards) would be approximately the same as presented. However, given the compressed schedule, the number of workers required per year would likely be higher under this option (even if the mobilization of equipment occurs only once), since all the infrastructure requirements would essentially be the same. The annual construction phase employment estimates presented above under each of the action alternatives were based on a 4-year construction period. Under this combined phasing option, if the construction period is reduced to 2 years, the annual employment effects under each of the alternatives could double. This means that there would be more workers needed on an annual basis, but the total workforce requirements would be the same. The duration of the construction effects under this option would be shorter. The employment effects during the O&M phase would be the same as described above for each of the action alternatives.

Mining, Access, and Other Indirect and Cumulative Impacts

Past and present actions that have affected NAB/YKCA communities, including those communities closest to the proposed road, include mining development (e.g., Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, and state and federal hunting and harvesting regulations. Appendix H describes the past, present, and reasonably foreseeable actions considered in this analysis.

Mining Development

Appendix H, Section 2.1.4, Reasonably Foreseeable Mine Development Scenario, presents the hypothetical baseline scenario projects that would occur under the action alternatives. The District has major mineral exploration and development potential. It is characterized as one of the world's largest undeveloped copper-zinc mineral belts. Access to the region could spur the development of existing mining projects such as the Arctic, Bornite, Sun, and Smucker projects. The scenario assumes that these major District mineral projects currently in the exploratory phase would be developed because of road access. The potential economic effects of this mining development are presented here; the analysis considers how this development would affect employment, income, and tax revenues in the state.

The analysis was conducted by the University of Alaska Center for Economic Development (UA 2019), which was an update of the *Economic Analysis for the Ambler Mining Region* study done by Cardno (2015). Information summarized below is taken from these reports.

Construction and Operation Costs for the Mines

The costs for construction and operation of the mines were calculated based on the extent of the deposits and proposed plans for development of each mine. The information for the Arctic and Bornite projects is based on more advanced development plans than are available for the Sun or Smucker projects. Table 14 summarizes the construction cost estimate totals both as an overall total and an in-state total. The economic inputs for operation of the 4 projects are presented in Table 15.

Employment and Income

Mining activity in the District would support direct, indirect, and induced job growth. Ambler Metals (formerly Trilogy) estimated that approximately 400 permanent jobs would be provided during operations of the Arctic Mine (Trilogy 2018a). Trilogy's PFS estimated the labor force for processing-plant O&M would be 163 (Trilogy 2018a). The study indicates additional labor would be needed for administration; surface support services; and mining services such as drilling, blasting, loading, hauling, stockpile construction, road building and maintenance, and pioneering and clearing work to support continuous operations 24 hours per day, 365 days per year. To support the labor needs, Ambler Metals plans a permanent camp to provide room and board for 450 and a temporary camp during construction to house an additional 200 for the Arctic Mine (Trilogy 2018a). Cardno (2015) estimated the direct jobs attributable to operations of the Arctic Mine at 482. Based largely on the Arctic Mine, direct employment at Bornite, Sun, and Smucker was estimated at 324, 374, and 354 jobs, respectively (Cardno 2015). Total job growth is expected to be many times greater than just the activity occurring in the District. In addition to the direct jobs, the mining activity would also support indirect and induced jobs due to off-site economic activity. For total average annual jobs (direct, indirect, and induced jobs) attributable to the 4 mines, Cardno (2015) estimated 3,187 jobs and the UA Center for Economic Development (UA 2019) estimated 3,931 jobs. The following paragraphs present further detail from the UA (2019) report. Table 15 provides a summary of the estimated employment and income impacts associated with the construction of each major District mining project. All results shown are annual averages, assuming that the construction phase lasts 3 years for Arctic and Bornite and 2 for Sun and Smucker. Arctic would have the largest employment effects during both construction and operations, creating an average of 799 total jobs for each year of construction and 1,663 jobs for each year of operations; refer to Table 16. The 2019 UA economic report assumed an employment breakdown for non-residents, NAB/YKCA residents, and other Alaska residents for each mine, with non-NAP/YKCA residents filling 19 percent of jobs, NAB/YKCA residents 20 percent, and non-local Alaskans getting the remaining 61 percent. For operations, the 25 percent of mining jobs assumed to go to non-residents were already factored out of the analysis. The resident mining jobs are estimated to be 30 percent held by NAB/YKCA residents and 70 percent other Alaska residents. During the construction phase, it is anticipated that 92 NAB/YKCA residents would be employed each year.

Table 17 provides a summary of the estimated employment and income impacts associated with the operation of the 4 mining projects. Arctic and Bornite are the 2 largest prospects and would generate larger employment impacts than Sun and Smucker. They also have longer estimate life spans at 12 and 21 years,[73] respectively. The development of these 2 mines makes Sun and Smucker more likely to be developed, since the larger mines justify the investment in access roads and other infrastructure that benefit the District as a whole. The statewide operational employment effects of the mines is estimated to be 3,931 jobs.

The experience of the Red Dog Mine operated by Teck in the NAB suggests that mineral development could increase jobs and personal income in the NAB/YKCA communities, particularly if there are job training programs as well as local hire preferences. During the operations phase it is anticipated that 92 regional residents would be employed each year at the mines.

Incorporated in these statewide income and employment figures are benefits to the trucking industry generally, to the Alaska Railroad Corporation that is expected to carry the ore containers from Fairbanks to a port such as the Port of Alaska in Anchorage, to the port itself, to Anchorage and Fairbanks

[73] The economic analysis is based on the UA (2019) analysis and does not match in every detail the scenario presented in Appendix H, Section 2.1.4, Reasonably Foreseeable Action Scenario. For example, Bornite is assumed by UA to have a 21-year life and in Section 2.1.4 to have a 35-year life.

companies that transfer containers between transportation modes, and to air transportation that is likely to carry workers back and forth from Fairbanks or villages to the mining district. In general, the Fairbanks and Anchorage economies would benefit. According to the Port of Alaska in Anchorage's comments on the Draft EIS, this activity would generate outbound freight revenue that could be used to fund needed port improvements. These improvements would benefit all port users as well as those who purchase goods brought into Alaska through the Port of Alaska in Anchorage.

Mining-related jobs would be a long-term, temporary effect and would be lost once the mines closed. Although this would, in effect, be a reversion to existing conditions, it would be perceived as an adverse economic effect at the time unless there were a clear source of replacement employment.

Employment opportunities in mining projects could also lead to depopulation of some NAB/YKCA communities due to migration to urban centers, the effect on the range and level of local public services and facilities could be negative.

Finally, there is concern raised during the scoping process that an increase in non-local industrial workers could increase crime in communities including the potential for increased sexual violence. The health impact assessment discusses this issue in more detail (NewFields 2019).

State and Local Government Effects

AIDEA expects to collect sufficient payments from road users to recover the cost of road construction and operation, together with the cost of debt financing, similar to AIDEA's DMTS, which supports the Red Dog Mine (Tappen 2019). Based on information from AIDEA (Tappen 2019), 30-year bonds would be repaid through a 50-year lease agreement with mining companies. Table 18 illustrates an example arrangement. The major component of the lease payment would be a Minimum Annual Assessment (MAA), which is a payment amount designed to entirely cover the project's debt service by marking up the interest rate at which AIDEA is able to bond. In the DMTS agreement, the MAA rate is 6.5 percent, while AIDEA bonds have rates that range from 4.75 to 5.25 percent. Additional fees may be incorporated, as they are for the DMTS, but are not necessary for AIDEA to repay the debt. Road O&M costs are a pass-through expense paid by road users.

Table 18 shows the principal and interest for bonds issued by AIDEA and for an MAA by AIDEA for road users. The table shows that MAA payments for 50 years would provide more revenue than needed for AIDEA to repay the bonds.

Using the assumptions outlined in Table 18, the debt service for the Ambler Road bonds totals $797.4 million. This figure represents the project's break-even point and the minimum amount of lease payments AIDEA must collect from all road users over the project's 50-year life span. AIDEA expects the Ambler Road project to serve 1 or more operating mines in every period of its initial 50-year life span. Therefore, annual lease payments would completely cover annual bond payments during the 30-year repayment period.

The anticipated source of funds to finance the project is revenue bonds. AIDEA indicates there will be no use of state or AIDEA funds. Rather, revenue bonds would be sold in the bond markets to various investors, and the bonds would be rated and backed by the financial strength of the underlying project. The bonds would not bear the obligation of the State of Alaska. Excess funds are anticipated to remain within AIDEA for its projects. That is, the State of Alaska General Fund would not directly benefit from MAA payments and also would not be liable for bond payments.

However, additional revenues would accrue to the State of Alaska if mining projects came online. The state collects revenues from the mining industry through claim rentals, production royalties, payments in

lieu of labor, land rental, lease sale bonus payments, material sales, miscellaneous fees, fuel taxes, corporate income taxes, and mining license taxes. Table 19 provides a summary of state revenue estimated to be generated by the development of the 4 mining projects in the District. The State of Alaska is projected to receive approximately $1.1 billion over the lives of all 4 mines. Roughly half of that amount would come from Arctic, 40 percent from Bornite, and the remaining 10 percent from Sun and Smucker together.

Table 20 provides a preliminary estimate of local government revenue estimated to be generated by the development of the 4 mining projects. Using the Red Dog Mine as a comparison, there are 2 local government revenue sources worth noting for their impacts to the NAB/YKCA region. Primarily, the Payment In Lieu of Taxes that would be paid to the NAB, and the Village Improvement Fund intended to be used to support community programs, services, infrastructure, and the long-term sustainability of rural communities in the NAB/YKCA region. It is estimated that these 2 sources could contribute $193 million in local government revenue over the lives of all 4 mines.

The O&M phase of mining development in the District would also generate economic benefits for ANCSA corporations. NANA owns the land in which the Bornite project is located (Cardno 2015). As with the Red Dog Mine, which is also located on NANA land, the Bornite Mine likely would be developed under an operating agreement specifying that NANA shareholders receive direct and meaningful benefits from development at the mine. As landowners at the mine site, NANA would receive income through lease, surface use agreement, and royalty payments, and the mining company or NANA may fund scholarships. These proceeds would allow NANA to create economic opportunities for shareholders through the development of NANA businesses, job creation and training, enhanced education, and dividend distributions. Funds paid to the NAB and NANA would help fund education, search and rescue, community infrastructure, and other efforts in the region and could be important replacement for funds that would be lost when the Red Dog Mine closes.

Mining development would have a positive economic impact on other ANCSA corporations as well. As with all subsurface resource development projects on ANCSA Regional Corporation lands (excluding industrial minerals such as construction gravel), 70 percent of project royalties received by NANA would be shared with other regional corporations under the Section 7(i) clause of ANCSA. A further provision of ANCSA calls for distribution of a portion of these shared royalties to village corporations and individual "at-large" shareholders holding only shares of a regional corporation and not a village corporation. In addition, ANCSA corporations could potentially benefit from providing goods and services to the mining companies conducting exploration and operations in the District.

There is the potential for economic costs to the state, borough, and local communities downstream of the mines in the Kobuk watershed as well. During the operation of mines and after mine closure, tailings water would be contained behind dams at the mine sites, and water discharged would be monitored and treated for decades, possibly in perpetuity. While financial surety instruments (similar to the posting of a bond) would be in place to ensure monitoring and corrective action when necessary, it is possible over the next century or more that mining companies would go out of business or be financially unable to respond adequately when there was a problem, and that the bond would be insufficient. The monitoring and mitigation effort could be abandoned or need to be taken over by the government—a cost to the public as a whole. Untreated water discharge, leaks, or catastrophic dam failure (e.g., from earthquake or unusual high water event) could pollute the Shungnak, Kogoluktuk, or lower Ambler river and Beaver Creek, and the Kobuk River downstream of the confluences of these streams. Depending on the nature of the pollution, this could affect community use of the water for drinking, boating, and subsistence harvest of fish and wildlife. Foregoing these uses or substituting other foods or water sources temporarily or long-

term would be a cost locally. Fixing the problem or cleaning up a mine site could incur large costs to the government.

The direct effects of all phases of the potential mining projects on local public infrastructure and services would not be readily noticeable. The temporary and long-term camps housing mine workers would be self-contained, and they would be operated and maintained by the mining companies throughout project construction, O&M, and closure, reclamation, and monitoring.

The indirect impact of the potential mining projects on local public goods and services is difficult to predict given the conflicting potential effects of mining project construction and operations on the population sizes of NAB/YKCA communities. On the one hand, the revenues that the NAB and NANA would receive as a result of mining development in the District would likely have the same positive impact on local public infrastructure and services as revenues from the Red Dog Mine have had. NANA and borough revenues could be used to support social services throughout the borough (DOWL 2016). In addition, the jobs and economic stability that the mining projects would create could ease population reductions in NAB/YKCA communities by stemming outmigration. Stemming outward migration would help ensure that an adequate level of public facilities, such as utilities, schools, and health clinics, is maintained in the communities.

On the other hand, some mine employees from NAB/YKCA communities may not continue to reside in the region after they are hired. Mining has high average wages and allows workers to live where they prefer and commute to the work site on a rotating schedule (DOWL 2016). About half of the NANA shareholders recruited to work at Red Dog decided to move their families and live outside the NAB for lifestyle and/or economic reasons (Tetra Tech 2009).[74] These shareholder employees rotate out at the end of their work shifts to homes primarily in Anchorage (Bradner 2011). Teck provides transportation between the mine and these alternative places of residence, and steady employment has given workers the financial means to relocate (Tetra Tech 2009). Should employment opportunities in remote mining projects in the District lead to depopulation of some NAB/YKCA communities, the effect on the range and level of local public services and facilities could be negative which, in turn, could prompt further outmigration. It is difficult to predict the number of NAB/YKCA residents employed by mining projects in the District that would choose to reside outside the region during their employment with the projects.

Also difficult to forecast are the effects of mining development in the District on the overall economic and social well-being of individuals and families in NAB/YKCA communities. Rotating shifts at a remote mining project would involve long periods away from home, which have been blamed for marital discord and family dysfunction (Tetra Tech 2009). Moreover, income from employment in mining projects could be spent in ways that are beneficial or adverse. In general, benefits arise where increased income leads to improved lifestyles, living conditions, and health risk behaviors of individuals and their families. Income that is spent in ways that worsen lifestyles, living conditions, and health risk behaviors is considered unfavorable. To the extent that these and other negative social problems occur, they could be mitigated by improving health and social services program in communities.

Some comments on the Draft EIS indicated a sense of disproportionate effects between residents of different parts of the study area or between members of different Alaska Native corporations. "They will get the royalties; we will get the pollution" is an example. Because the Bornite Mine site is on NANA lands, NANA village corporations and residents of the NANA region would stand to benefit from payments made by the mining companies. Doyon region residents would have tens or hundreds of miles of road with potential impacts, as detailed in the main body of the EIS, and would see less economic

[74] In comments on the Draft EIS, NANA indicated that data show the opposite—that workers in the NANA region who hold mining jobs stay in their local community. However, the comment did not include the source of the data.

benefit. However, AIDEA would need to negotiate access across Doyon lands, so Doyon may be able to leverage some degree of compensation for the inequity.

Access

Beyond providing industrial access to the District, communities could experience effects from secondary uses. Appendix H, Section 2.2, Road Access Scenarios, describes road access scenarios including commercial access (see Section 2.2.1, Commercial Access Scenario) and public and non-industrial access (see Section 2.2.2, Public and None-Industrial Access) that could affect the communities in the region. As noted, it is reasonable to assume that once the road is constructed, local residents within the general area of the road, as well as other residents within Alaska, will seek ways to access the road both lawfully and unlawfully.

The proposed Ambler Road would directly connect to the Kobuk road system under Alternative C, and it is reasonably foreseeable that the existing Bornite-Kobuk road would be connected to Alternative A or B to support the Bornite and Arctic mines. Otherwise, the Ambler Road would not connect directly to any existing communities, and AIDEA does not propose additional work outside the approved ROW to accommodate any direct connections. At least initially, fuel or freight likely would be delivered to staging areas where the communities could access it, probably in the winter (DOWL 2016).

Over time, study area communities might seek and be granted permits necessary to construct spur roads that would give them year-round access to the Ambler Road. Kobuk has the most potential to benefit from the road in terms of having fuel and/or freight delivered directly to the community under any alternative via connection to the existing road system. Shungnak is several miles away from Kobuk, but it has expressed interest in constructing a road to provide access to the Bornite Mine area. Ambler is approximately 30 miles from Kobuk, but it has the potential to access the proposed endpoint of the road at the Ambler River (DOWL 2016).

Cost of Living

AIDEA's application indicates that a secondary benefit of the proposed road would come from commercial access for communities closest to the road, creating opportunities for less expensive transportation of goods to and from some NAB/YKCA communities. Although access to the road would be controlled during operation, the study area communities would have the potential to use the road to receive deliveries of fuel and freight. Only commercially licensed drivers would be allowed on the road for these purposes. The communities could hire commercial transportation providers or could form their own companies to provide these transportation services. The following describes potential changes in the costs of transporting fuel and freight as well as access to gravel that affect the cost of living the region.

Transportation of Fuel

It is anticipated that the logistics of delivering fuel to socioeconomic study area communities would change for some communities under all the action alternatives. Rather than seasonal barge or winter road shipments or air shipments, fuel, including diesel fuel for heating and electricity generation and gasoline for vehicles, could be transported directly via tanker truck from the Petro Star refinery in North Pole.

While many factors contribute to the cost efficiency of vehicles traveling on a roadway (e.g., speed, size of vehicle, tire type, road grade), it costs less to drive a pound of cargo than to fly a pound of cargo between 2 points. However, on a per-pound, maximum-load basis, road travel is typically less efficient than travel via barge when shipping large quantities of fuel over long distances (Northern Economics 2010). However, those communities closest to the new road (Kobuk and possibly Shungnak, under all alternatives, and Hughes under Alternative C) may switch from receiving their fuel shipments by barge to

obtaining them by truck, as year-round truck delivery could reduce fuel storage and inventory costs and mitigate cash flow issues associated with community fuel purchases. Moreover, rather than being compelled to pay the price of fuel during seasonal barge deliveries, communities could take advantage of swings in fuel prices and order fuel during price drops throughout the year. Wilson et al. (2008) note that all Alaska communities on the state road system have fuel delivered by truck.

Ultimately, the cost savings that would accrue to community residents as a result of trucking heating fuel and gasoline along the Ambler Road would depend on retail price-setting practices at the community level. Retail prices depend on fuel sale operating hours and costs; safety and environmental compliance implementation levels; collections for tank-farm repair and replacement and O&M practices; the cost of debt for bulk fuel loans; and mark-ups to collect revenues for local public services, such as washaterias and community water and sewer systems (Szymoniak et al. 2010).

The Ambler Road would lower the cost to produce electricity in study area communities if the utility companies supplying electricity experience savings by purchasing larger volumes of fuel at lower unit rates and/or decreasing transportation costs for delivery. However, these savings may not directly lead to lower residential costs for electricity, as the State of Alaska, through the Power Cost Equalization Program subsidizes residential electricity costs in all the study area communities. Electricity customers who are not eligible for the program, including schools and businesses, could benefit if the cost of transporting fuel to communities decreases due to road access.

Over time, the Ambler Road could also potentially lower electricity costs in study area communities by facilitating the development of electrical transmission lines along the road corridor; however, maintenance of these transmission lines would be difficult when the proposed access road is reclaimed as proposed by AIDEA. It is estimated that a road corridor reduces the cost of building electrical transmission infrastructure by between 30 and 50 percent per unit mile (Northern Economics 2010). Energy savings are realized when higher cost energy in 1 area can be displaced with lower cost energy imported from another area via an intertie (NANA Pacific 2008). Even at a more localized level, if 2 communities are connected by a transmission line, the fixed costs of electricity generation can be shared by both communities (Szymoniak et al. 2010), as is the case with Kobuk and Shungnak today. Moreover, larger generators are more efficient than smaller generators, and increasing the demand by an intertie could lead to additional reductions in electricity costs.

In addition, road access could create opportunities for communities to replace distillate fuels for electric power and heating with alternative fuels. For example, a study by Northern Economics (2010) noted that several entities have proposed the use of LNG or propane to reduce the cost of energy throughout rural Alaska, particularly if the price of crude oil increases. The study concluded that trucked propane fuel could be cheaper than barged or air flown distillate fuel if a road corridor allows communities to receive regular shipments of propane.

Transportation of Freight

Trucking is less expensive than either barging or flying for freight shipments, even over long distances, because trucks can more efficiently handle small, mixed loads destined for multiple parties (Northern Economics 2010). If spur roads connected communities to the Ambler Road, as is likely for Kobuk (all alternatives), possible for Bettles/Evansville under Alternatives A and B, and likely for Hughes (Alternative C), household goods could be driven directly to study area communities from a major hub such as Anchorage or Fairbanks. In the absence of spur roads, household goods could be delivered to staging areas assuming proper handling and adequate storage is provided at each area. However, perishables and non-durable consumables would likely continue to move via the Alaska Bypass Service program. Non-dry good perishables (e.g., fresh fruits, vegetables, frozen goods) compose about 19

percent of the bypass mail volume (Northern Economics 2013). Non-perishable foods, non-food items, and most beverages, which account for the remaining 79 percent of the bypass mail volume, could be trucked. Except for oversize items, it is also likely that much of the construction equipment and materials currently transported on barges would move to truck delivery to these communities with the availability of a road. Alatna, Allakaket, Ambler, and Tanana are farther from any of the alternatives in locations where spur roads are far less likely to occur and even snowmobile or boat access for taking delivery of goods likely would be rare.

Trucking freight would result in savings for the U.S. Postal Service due to the lower bypass mail volume, but it is uncertain how much it would lower the prices of household goods for community residents. Residents are already paying a rate below cost for bypass mail delivery. Moreover, the prices for final consumers is largely determined by the price mark-up practices of local retail stores.

Should a spur road to a given community be constructed, it is uncertain if the U.S. Postal Service would choose to continue bypass mail service to that community. In at least 1 instance, a road was constructed to a bypass destination, but the bypass program continued, albeit via tractor-trailer rather than air (U.S. Postal Service 2011). The U.S. Postal Service has made efforts to cut the costs of the Alaska Bypass Mail program by making greater use of surface transportation modes. Recently, for example, the U.S. Postal Service considered partnering with Lynden Transport Inc. to use tractor-trailers to deliver bypass mail during at least part of the year (Brehmer 2019).

Even if the Ambler Road resulted in lower prices for store-bought food, it is not expected that these food items would completely replace food from subsistence harvests. As discussed in Section 3.4.7, Subsistence Uses and Resources, economic considerations only partly explain the importance of subsistence foods; local culture and identity are closely linked to a diet heavily dependent on subsistence resources. Further, it is possible that subsistence activity could increase if road access led to decreased cost of hunting and fishing supplies.

If freight deliveries were made using the proposed road instead of by air cargo, air carriers may experience a loss of revenue. This may impact the cost and/or availability of passenger and cargo air travel in area communities.

Access Gravel Sources

A road connection to Kobuk, or to another community if that community built a spur road connection, could provide improved access to gravel sources for each community. Gravel access is an important cost factor in construction and maintenance of community infrastructure projects, including airports, landfills, community streets, and housing pads/subdivisions (NAB Planning Department 2008).

Community Services

There are other ways in which the improved accessibility provided by the proposed road could affect the study area communities. Permitted traffic might include emergency response authorized through access permits and improved accessibility could facilitate evacuations for natural disasters. Furthermore, it could reduce the costs of providing access to communities by Alaska State Troopers and an enhanced police presence and improved response time could reduce local crime.

Improved accessibility could also facilitate the removal of hazardous and recyclable waste from communities. The accumulation of these waste materials creates health and environmental risks for rural villages. Back-haul of waste material with airfreight is often unaffordable. With a road, each community could provide economical back-haul of unsightly and potentially dangerous waste material.

Rural Lifestyle

Many comments received during the public comment period expressed concern over how the project would further change the way of life for people living in the Alaska Native communities. Citing the cultural practices of their ancestors, subsistence activities that sustain them, and traditions that get passed from generation to generation, the commenters frequently described how these qualities of life have changed since the late 1960s/early 1970s when the Dalton Highway and TAPS were built. They describe their history of living on the land, how they feel connected to it, and how they rely on its resources. They also describe a decline in resource availability and relate it to the introduction of roads, mines, pipelines, and competition from sportsmen in recent years. Some comments expressed the changes as having been brought on by people from "outside" (i.e., people who come to this part of Alaska take the resources and leave the communities with unmitigated and long-lasting effects). The effects of climate change on resources were also cited as having an effect on life in the villages. Commenters described the peace, quiet, beauty, and wildness of the land and expressed concern that those qualities of the land are in jeopardy from increased human presence and activities.

The BLM acknowledges that the Alaska Native communities potentially affected by the project have experienced impacts from past transportation and resource extraction projects, as well as current land use policies that allow recreation uses and economic development in areas that are also used by rural residents for subsistence activities and traditional practices. The BLM evaluated the project impacts on subsistence resources and subsistence activities in Appendix L. Appendix L, Section 6.4.1 in particular, describes the cultural impacts that occur over time as a result of reduced subsistence use:

> If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge these areas as part of their traditional land use area, the loss of direct use of the land could lead to reduced knowledge among the younger generation of place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

The BLM recognizes that, as opportunities for access and development increase in remote regions of Alaska, the lifestyle and culture of Alaskan Native communities in those regions also change. The isolated communities will continue to experience encroachment in areas that they have relied on for cultural and traditional practices.

Public Health

Improved access could result in a mixture of positive and negative impacts on public health. For example, access to cheaper building materials could make constructing or maintaining water, sewer, or other health-related infrastructure less expensive. Improved commercial access could lower distribution costs for clinic supplies. Increased economic benefits of job access at potential mines may decrease the number of food-insecure households. Section 3.4.7 (Subsistence Uses and Resources) provides information on which communities are likely to experience subsistence impacts. Furthermore, improvements in road and

air infrastructure (i.e., new landing strips associated with road construction and maintenance) would facilitate redundancy for emergency evacuation for health-related emergencies or during disasters for communities (see Section 2.2, Road Access Scenarios). There could also be potential health improvements due to access to fiber-optic cable infrastructure because faster and more stable internet/telecommunications would facilitate telemedicine.

Increased access to communities however may also increase the potential for bringing drugs, alcohol, and other prohibited substances into the communities (NewFields 2019). Social or cultural impacts could occur without additional government or community plans to increase police or safety officer presence (see Appendix L, Section 6.4, Road Impacts, for discussion). AIDEA has proposed design features such as a staffed gate at the Dalton Highway end of the road, which is intended to prevent public access along the road (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). This would help to curb the potential for bringing these items into the communities.

A fly-in-fly-out workforce at the mines could have mixed effects on community cohesion (e.g., employed adults may relocate to urban areas but send remittances back to the villages) with health-related effects from psychological stress. Increases in communicable diseases related to in-migration and increased incomes are a concern and often associated with the boom and bust cycle. Increases in vaccine-preventable diseases are possible in association with large construction work camps. Kobuk, and possibly Shungnak and Ambler, would see the most potential for indirect and cumulative health effects from the proposed road and mining in the District because of their proximity to the mines and likely access of mine workers to and from the mines via the Dahl Creek airstrip. For more discussion, see the Health Impact Assessment (NewFields 2019).

Areas targeted for mining likely contain NOA, and disturbing the ground for development of mines could release dust containing asbestos. The dust is most likely to be hazardous to mining employees who work where the dust is concentrated, and OSHA regulations may govern the mining workplace to help protect workers. Fine particles of asbestos may remain airborne longer than visible dust and may drift off site but would be dispersed in the atmosphere with distance from the mine sites and would be much less likely to affect people passing nearby or to affect the nearest communities, which would be many miles away. While road builders may use NOA materials in the road embankment and contain the asbestos beneath a capping layer, mining companies may not be able to contain mining dust during excavation of open pit mines and transport and disposal of many tons of material.

Tailings, or the mineral material left after the marketable minerals are extracted from ore, typically contain hazardous levels of metals that would be contained behind dams at the open pit mine sites. Dams and water quality would be monitored during mine operations and for decades, possibly in perpetuity, after mine closure. The intention is that the mining companies would be responsible for monitoring and any corrective action needed, and financial surety instruments, such as a bond, likely would be in place to ensure that this work could be done even if the mining company were to fail in the future. There are risks to public health in the Kobuk River drainage of discharged water not being properly treated, or of leaks from impounded tailings water, or of catastrophic dam failure (e.g., from an extraordinary high water event or an earthquake). The risks are related to ingestion of pollutants through downstream domestic water uses or contaminated fish and wildlife, and reduction of subsistence food sources if fish, birds, or wildlife were made ill or died.

Climate change is likely to thaw permafrost, releasing mercury that has been frozen in the soil. This could result in higher mercury levels in water and in wildlife. Permafrost areas are estimated to contain nearly twice as much mercury as the rest of the world combined (Sneed 2018), and mercury is known to bioaccumulate in muscle tissue of fish, other wildlife, and humans, and can cause damage to the nervous

system and other bodily functions, particularly to fetuses (World Health Organization 2017). The road project, combined with the mining projects and global climate change, would likely hasten thawing of permafrost where soils were disturbed, adding in a small way to the health risk of mercury in wildlife and in a human subsistence diet. As noted above, metals such as mercury and selenium also could be released to the Kobuk River drainage from mining operations in the District.

Other Reasonably Foreseeable Actions

Additional socioeconomic impacts in the Ambler project area are expected as a result of other actions. Arctic oil development, the Mahn Choh Mine, and changes at the Red Dog Mine could somewhat alter the availability of jobs and the level of economic activity in the extended region. The Ambler mine jobs discussed above would work to offset the Red Dog Mine jobs and the funds that flow through NANA and NAB to the communities when the Red Dog Mine shuts down.

Continued climate change could further stress poor communities in the region by affecting flooding, permafrost, and infrastructure as well as altering access to traditional subsistence resources. While these are poorly defined, they would be cumulative with the Ambler Road and District projects. Dalton Highway improvements likely would be minor and would have little socioeconomic impact in area communities.

3.4.6 Environmental Justice*

Affected Environment

EO 12898 states “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations,” including Alaska Native Tribes. This EO was supplemented by EO 14096, Revitalizing Our Nation’s Commitment to Environmental Justice for All, April 26, 2023, which directs federal agencies, as appropriate and consistent with applicable law, to identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of Federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns. Appendix F, Table 21, identifies minority and low-income populations among the 66 study area communities; nearly all communities listed are EJ communities based on minority and/or low-income metrics, and almost all are associated with a Tribe. The communities that did not meet the criteria for EJ communities were Coldfoot, Wiseman, and Bettles. Communities in the study area with proportionally larger Alaska Native populations often have the highest poverty rates. Generally, unemployment within the study area communities is high, with typical unemployment rates in the double digits. It is important to note that unemployment data do not include persons who are not actively looking for work. For example, some individuals may eschew participation in the cash economy in favor of maintaining a culturally traditional subsistence lifestyle.

Environmental Consequences

An impact related to EJ is considered to occur if an alternative would disproportionately adversely affect EJ communities through its effects in any of the impact categories in this chapter. These may include impacts to water and air quality, vegetation and animals (especially those used for subsistence), or impacts to subsistence, local socioeconomics, and cultural resources. For the physical and biological environment topics, the impact may be related to EJ if it affects communities of people rather than the just the resource itself.

CEQ guidance in a presidential memorandum transmitting EO 12898 indicates the federal agency is expected to provide opportunities for community input into the NEPA process. Because of the known likelihood of effects to EJ communities, the BLM has ensured outreach to the communities in the area during scoping and review of the initial EIS as well as scoping for the Supplemental EIS. See Chapter 1, Section 1.6, Collaboration and Coordination, for a brief summary. Efforts for the initial EIS included public scoping meetings and Draft EIS public hearings in more than 20 communities, including offers to secure translation services between English and Alaska Native languages, and meetings with Tribal and non-Tribal community leaders. The BLM provided each community with a hard-copy of the initial Draft EIS. Outreach efforts for the Supplemental EIS are outlined in Chapter 1, Sections 1.6.1 (Scoping and Key Issues) and 1.6.4 (Draft Supplemental EIS Review). Public input received during the scoping process is summarized in the Scoping Summary Report (Appendix K).

Appendix F, Table 22, summarizes the project's potential impacts by resource category to provide context for the EJ analysis and helps to illustrate the likelihood and magnitude of impact. Impacts to subsistence use and resources and socioeconomics (public health) would be among the most important high and adverse effects, based on public comment received from the communities and the analysis elsewhere in this Supplemental EIS. Specific resource sections in this chapter and associated technical reports contain more information about the likelihood, magnitude, duration, and extent of impacts. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. Given the impact summary shown in Appendix F, Table 22, the BLM has determined that the project under any action alternative could have disproportionately high and adverse impacts to residents of EJ communities.

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in any impacts to areas of potential environmental justice concern listed in Appendix F, Table 22, and therefore would have no disproportionately high and adverse effects on minority and low-income populations. The economic conditions at the local, regional, and state level would be expected to continue along current trends (e.g., high levels of unemployment, low incomes, high costs of living); no beneficial or adverse economic impacts from the road would occur. Air traffic to support mineral exploration would continue under the No Action Alternative and associated effects to subsistence uses and resources would have continued effects on EJ populations.

Impacts Common to All Action Alternatives

The impacts to minority and low-income populations would be similar for all action alternatives and would be similar for each project phase. For each action alternative, the adverse resource impacts would be most severe in those communities in closest proximity to the road. All action alternatives would affect Kobuk by direct road connection, and Shungnak and Ambler because they are relatively close to Kobuk and the project. However, the adverse resource impacts of the project could be experienced at some level in all the study area communities.

Impacts to resources are discussed in their respective sections and in Appendix F, Table 22, which helps to define likelihood and magnitude of impact. Some disproportionately high and adverse effects on minority and low-income populations would occur, including potential reductions in subsistence resource abundance and availability, increased exposure to public health risks, and damage to ethnographic resources and cultural properties, as further described below.

At the end of the Ambler Road's 50-year life span, the road would be closed and reclaimed. Effects of the road would be removed from the area, including road maintenance jobs, traffic effects on wildlife, and the

road's restrictions on land use. The road corridor restrictions on public use would be lifted, and residents from nearby communities would no longer be constrained in their movements by the presence of the road. Subsistence use patterns may be at least partially restored. However, it is possible that some adverse impacts would persist and continue to fall disproportionately on EJ communities. For example, some public health effects such as diet changes could become ingrained in the local culture, or if wildlife or fish populations or movement patterns had been altered by the road, it is not clear that they would revert to 2020 conditions upon closure and removal of the road.

Subsistence Uses and Resources. Effects to subsistence resources (see Section 3.4.7, Subsistence Uses and Resources) are of high importance to the study area communities listed in Appendix F, Table 21. More specifically, the subset of communities listed in Appendix F, Table 23, in the Subsistence section, is considered the group of communities where EJ is an issue for this project (minus Bettles and Wiseman, which are not EJ communities). The analysis of subsistence effects considered subsistence use areas, harvester access, and resource availability. Areas where an alternative would bisect a community's subsistence use area or intersect a portion of the subsistence use area would experience the greatest subsistence impact (see discussion below by alternative). The road itself would impede access to subsistence resources and, by fragmenting habitat, availability of resources. Additionally, effects to subsistence resources in the region also would have negative impacts to the extensive sharing networks between the villages and their families living in urban centers such as Anchorage and Fairbanks. With less abundance, availability, and access to subsistence resources, families living in urban centers will likely have discontinued access to traditional foods. Spills or chronic production of toxic materials or dust in water could also reduce subsistence resource availability by damaging important fish habitat. Other potential impacts to subsistence resources and uses could result from project-related noise, traffic, and infrastructure (including physical barriers). Due to the economic, cultural, nutritional, and social dependence on subsistence resources, the potential reductions in subsistence resource abundance and availability resulting from the project would have a disproportionately adverse effect on EJ communities in the study area, particularly those nearest to the road.

Socioeconomics and Communities (Public Health). Potential adverse public health impacts (see Section 3.4.5, Socioeconomics and Communities) may be concentrated in the minority and low-income communities closest to the road alternatives. A number of these effects, such as a possible increase in the number of food-insecure households and increases in psychosocial stress at either a household or individual level, may be related to decreased access to subsistence resources. Stresses on communities have been among issues expressed to the BLM in government to government and other local meetings in the project area.

In addition, there is potential for high and adverse impacts due to easier importation of drugs and alcohol and mixing with typically young, single male road crews (see Health Impact Assessment (NewFields 2019), but limits on crew travel to local communities from their work sites is expected to mitigate the impact. If high and adverse impacts did occur, they would fall disproportionately to EJ communities in the villages closest to the alternatives. Other potential adverse public health effects that may disproportionately affect minority and low-income populations due to their proximity to the proposed road include increased exposure to NOA materials and exposure to hazardous waste spills and toxic road dust.

The construction and operation of the proposed road are expected to provide employment for residents of NAB/YKCA communities (see Section 3.4.5, Socioeconomics and Communities), most of which have predominately minority populations and large low-income populations. However, the minority and low-income populations in these communities are not expected to receive project-related employment benefits in greater proportion or degree than other populations in the region or the general state population. The

residents of Kobuk and likely 2 to 3 other EJ communities in the study area are expected to experience a reduction in the costs of fuel and other goods as a result of road construction. These impacts would lower the cost of living for minority and low-income populations in those communities.

Cultural Resources. There is potential for impacts to known cultural resources and to potentially historic trails (see Section 3.4.8, Cultural Resources). There is high likelihood that there are ethnographic resources and cultural properties in the proposed road corridors that have not yet been identified and that adverse impacts would occur to them. These adverse impacts would affect the legacy of these sites for all Americans but likely would be felt most strongly among members of local Alaska Native Tribes.

Alternatives A and B

Alternatives A and B cross mapped subsistence use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman. These alternatives are most likely to have the greatest effect on the EJ communities of Evansville, Kobuk, and Shungnak because their subsistence use areas are bisected by the alternatives (see Appendix F, Table 23). As a distinction between alternatives, Alternatives A and B would be likely to affect subsistence use and resources in Evansville, while Alternative C would not.

Under Alternatives A and B, the EJ communities with the greatest potential for impacts to human health are Ambler, Kobuk, Evansville, and Shungnak due to their proximity to the road. As a distinction between alternatives, Alternatives A and B would be likely to affect public health in Evansville while Alternative C would not.

Alternative C

Alternative C crosses use mapped subsistence use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, and Tanana. Alternative C is mostly likely to have the greatest impact on the EJ communities of Hughes, Kobuk, and Shungnak, because their subsistence use areas are bisected by the alternatives (see Appendix F, Table 23). All these communities are EJ communities; there are no non-EJ communities with similar proximity or effects. Therefore, all effects to communities near Alternative C would disproportionately fall on low income and minority populations. As a distinction between alternatives, Alternative C would be likely to affect Hughes, Stevens Village, and Tanana while Alternatives A and B would not.

Alternative C would have the same types of impacts to public health as Alternatives A and B. The EJ communities with the greatest potential for human health impacts are Ambler, Hughes, Kobuk, and Shugnak. As a distinction between alternatives, Alternatives A and B would be likely to affect public health in Hughes while Alternative C would not.

Combined Phasing Option

Under this alternative, there would be no impact differences when compared to Alternatives A, B, and C because impacts to subsistence and public health would not change.

Mining, Access, and Other Indirect and Cumulative Impacts

Past and present actions that have affected the areas of potential environmental justice concern include mining development (e.g., Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, and government hunting and harvesting regulations.

As discussed in Chapter 3, Section 3.4.7 (Subsistence Uses and Resources), the construction and operation of the proposed road, together with the mining development that the road would support, is expected to result in a reduction in subsistence resource abundance and availability. This reduction would have a disproportionately high and adverse impact on minority and low-income populations because of their economic, cultural and social dependence on subsistence resources. Changes in subsistence resource abundance resulting from climate change could contribute to changes in resource availability caused by road construction and mining development, thus further reducing their availability to minority and low-income populations.

Some potential adverse public health impacts of road construction and mining development may be concentrated in areas of potential environmental justice concern (see Chapter 3, Section 3.4.5 [Socioeconomics and Communities]). A number of these effects, such as a possible increase in the number of food-insecure households and increases in psychosocial stress at either a household or individual level, may be related to decreased access to subsistence resources.

In addition, there is potential for high and adverse impacts due to easier importation of drugs and alcohol and mixing with typically young, single male mine worker crews. Increases in the rate of violent victimization, particularly the rate of aggravated assault, have been reported in other areas of the United States that experienced a rapid increase in jobs and population as a result of resource extraction projects (e.g., Martin et al. 2019). Indigenous women are particular targets of gender violence and sex trafficking near camps where the majority of male extractive workers live (Kojola and Pellow 2021). Increased access to drugs and alcohol and potential for sex trafficking and gender violence has been a tribal concern shared during G2G consultation with the BLM. Other potential adverse public health effects that may disproportionately affect minority and low-income populations due to their proximity to the proposed road and mining development include increased exposure to NOA materials. For a detailed description of potential adverse public health impacts of large resource extraction projects see the Health Impact Assessment (NewFields 2019).

Some benefits would accrue to minority and low-income populations as a result of construction and operation of the proposed road and mines, including increased employment opportunities, expanded public services, and reductions in the cost of living due to changes in the logistics of delivering fuel and freight in some communities with high minority and low-income populations, provided the road allowed for commercial delivery of fuel supplies. As described in Chapter 3, Section 3.4.5 (Socioeconomics and Communities), road and mine construction and operation would provide opportunities for workforce training and development and employment for NAB/YKCA communities, most which have high minority and low-income populations. Those document sections also indicate that proposed mines located on land owned by NANA (e.g., Bornite Mine) may be developed under an operating agreement specifying that NANA shareholders receive direct and meaningful benefits from development at the mine and that this could sow seeds of resentment among some study area residents. However, in addition, the revenue the NAB and NANA would receive from mining development could be used to support public infrastructure and services in the region, which would be a long-term benefit to local communities. Construction of the proposed road could also reduce the costs of transporting goods to some NAB/YKCA communities and provide increased access to emergency and health care services.

3.4.7 Subsistence Uses and Resources*

Affected Environment

Subsistence is a central aspect of rural Alaska life and culture and is the cornerstone of the traditional relationship of Alaska Native people with their environment and was recognized as such by Congress in ANILCA Title VIII. Residents of the study communities rely on subsistence harvests of plant and animal

resources both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural identity, and provide a link between contemporary Alaska Natives and their ancestors. Traditional knowledge, based on a long-standing relationship with the environment, guide these activities. More than just food, subsistence includes economic, social, cultural/traditional, and nutritional elements. In Alaska, a dual management system by the State of Alaska and federal government regulates subsistence hunting and fishing. Subsistence activities on all lands in Alaska, including private lands, are subject to state or federal subsistence regulations, with the state managing subsistence harvest of fish and wildlife on state and privately-owned land. ANILCA Section 802(2) allows the federal government to prioritize subsistence taking of fish and game on federal lands over other uses when it is necessary to restrict taking in order to assure the continued viability of the fish or wildlife populations.

In addition to state and federal management of subsistence activities, most study communities practice their own form of wildlife management which is based upon generations of Indigenous knowledge. Indigenous communities recognize that protecting the health and abundance of wildlife resources is essential to their cultural survival. Many Indigenous ethics and values are based on this concept and include not harvesting more than one needs; sharing one's harvest and respecting the animals to ensure future success; and waiting for the first of a caribou herd to pass by the community before hunting from the herd.

Subsistence is part of a rural economic system called a "mixed, subsistence-market" economy, wherein families invest money into small-scale, efficient technologies to harvest wild foods (Wolfe 2000). The combination of subsistence and commercial-wage activities provides the economic basis for the way of life so highly valued in rural communities (Wolfe and Walker 1987). Data show that subsistence in rural Alaska has remained stable over time, with the exception of some regional variation, regardless of income levels (Burnsilver et al. 2016). Thus, while the mixed cash economy is an important feature of subsistence in Alaska, economic growth or decline is not necessarily associated with corresponding increases or decreases in subsistence harvests.

All 66 study communities, including primary subsistence study communities, caribou subsistence study communities, and fish subsistence study communities, are listed in Appendix F, Table 23. Primary subsistence study communities for this Supplemental EIS are those located within 50 miles of the project alternatives, or with subsistence use areas documented within 30 miles of the project alternatives. There are 27 primary subsistence study communities (see Appendix F, Table 23, and Volume 4, Map 3-32). In addition, the project is within the range of the WAH, a highly migratory and important subsistence resource to communities in western and northwestern Alaska. While the action alternatives may affect the RMH and HHH, subsistence harvest of these herds is highly limited due to limited access, and data on these 2 herds are limited due to a lack of research priority (Pamperin 2015). The EIS analyzes a separate subset of the 42 member communities of the WACH WG; Volume 4, Map 3-32). These caribou subsistence study communities are referred to as the WAH study communities and include overlap with 16 of the primary subsistence study communities listed in Appendix F, Table 23. Inclusion of the WAH study communities captures potential indirect or cumulative impacts to communities who use caribou that migrate through the project area and are harvested elsewhere. Finally, the project crosses tributaries of several river basins, including the Kobuk-Selawik River, Koyukuk River, and Yukon River. Thirty-two communities are located downstream from these tributaries and harvest fish which could be affected by the project. These 32 fish study communities include overlap with 15 of the primary subsistence study communities and 15 of the caribou subsistence study communities (see Appendix F, Table 23). Data presented for the fish study communities are focused on the 3 key subsistence species (Chinook salmon,

chum salmon, and sheefish) with the greatest likelihood to experience downstream effects due to the presence of key spawning grounds for those species in the project area.

Despite various environmental, historic, social, and economic forces of change, subsistence remains a central part of life and culture in all of the study communities. The Subsistence Technical Report (see Appendix L) provides more detailed resource- and community-specific subsistence use data.

Subsistence Use Areas

Appendix L, Maps 2 through 27, depict subsistence use areas for all resources for individual subsistence study communities and are largely the result of efforts undertaken by the Alaska Department of Fish and Game. These maps illustrate the location and extent of potential impacts relative to the proposed alternatives. Sixteen of the 27 study communities have use areas overlapping with 1 or more of the project alternatives (see Appendix F, Table 23). The remaining 11 study communities have subsistence use areas within 30 miles of 1 or more of the project alternatives or are within 50 miles of a project alternative. Subsistence use areas are documented for varying time periods, including lifetime, 10-year, or 1-year time periods. Lifetime use areas are useful for capturing long-term trends in subsistence use patterns and the extent of traditional land use areas. Shorter time periods are useful for capturing "current" subsistence use patterns and revealing recent trends in subsistence use. It is important to include all time periods when establishing a baseline of subsistence uses, as residents may return to previously used traditional areas in the event of environmental or regulatory changes, or changes in resource distribution or migration. Current subsistence use areas are useful for analyzing the likely direct impacts of a project. Even if a community shows a change in traditional uses over time (e.g., constricted use areas), traditional land use areas are still important to cultural identity, and protection of traditional land use areas ensures the ability of communities to adapt to future changes.

Communities closest to the project alternatives (i.e., within 30 miles) include those surrounding the Koyukuk River (Alatna, Allakaket, Bettles, Coldfoot, Evansville, Hughes, Wiseman), Kobuk River (Ambler, Shungnak, Kobuk), and Yukon River (Rampart, Stevens Village, Tanana). Additional study communities in the Kotzebue Sound and Kobuk River regions (Kiana, Noorvik, Buckland, Selawik, Noatak, Kotzebue) harvest resources to the west and downstream from the project alternatives. Communities in the Koyukuk, Tanana, and Yukon River regions (Huslia, Galena, Beaver, Nenana, Minto, Manley Hot Springs) harvest resources to the south and east of the project alternatives. Anaktuvuk Pass (on the North Slope but included in the Koyukuk River region study communities) harvests resources to the north of the project alternatives. Subsistence use area maps show overlap between communities, which is reflective both of shared harvesting areas and kinship and social ties between communities. Residents often travel by river and overland to other communities within their regions to engage in subsistence activities, visit with family and friends, and attend feasts and festivals.

According to ADF&G subsistence data, subsistence use areas for the Kobuk River region study communities (Ambler, Kobuk, Shungnak, Kiana, Noorvik) are focused around the Kobuk River, including the Upper Kobuk River, and extend south toward the Koyukuk River drainage and north into the Brooks Range and as far as the North Slope of Alaska (see Appendix L, Maps 2 through 6). Residents' subsistence uses also extend downriver and into the marine waters of Kotzebue Sound and the Chukchi Sea. More recently documented subsistence use areas (Watson 2018; Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. In particular, recent studies show less extensive travel to the north of the study communities into the Brooks Range and onto the North Slope. Watson (2018) suggests that some of the shifts in use areas may reflect changes in WAH migratory routes; changes in traditional hunting methods to avoid diverting caribou during their fall migration (i.e., hunting them farther south); decreased need for extensive overland travel (e.g., less reliance on furbearer trapping); and increased reliance on fish resources (i.e., greater focus on riverine use areas). Except for Noorvik,

subsistence use areas for Kobuk River region study communities overlap with the western portion of the project alternatives.

According to ADF&G, subsistence use areas for the Kotzebue Sound region study communities (Kotzebue, Buckland, Selawik, Noatak) are focused around Kotzebue Sound; the Chukchi Sea coast; and lands and rivers surrounding Kotzebue Sound, including the Brooks Range and the Noatak, Kobuk, Selawik, and Buckland rivers (see Appendix L, Maps 7 through 10). More recently documented subsistence use areas for these study communities (Satterthwaite-Phillips et al. 2016) indicate a smaller extent of overland travel. Subsistence use areas for Kotzebue Sound region study communities do not overlap with the project alternatives but occur downriver from the alternatives or approach the project alternatives in overland areas from the west and north.

According to ADF&G, subsistence use areas for the Koyukuk River region study communities for this project (Alatna, Allakaket, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, Wiseman), are focused around the upper and lower Koyukuk River drainages and various tributaries of the Koyukuk River, Iniakuk Lake, the upper Kobuk River, and overland areas surrounding the Koyukuk River and into the Brooks Range (see Appendix L, Maps 11 through 19). Use areas for the northernmost Koyukuk River region study community of Anaktuvuk Pass extend onto the North Slope of Alaska and as far north as Nuiqsut, while use areas for the southernmost community of Huslia extend west to Kotzebue Sound and south to the Yukon River. More recently documented subsistence use areas for the study communities indicate various changes to contemporary subsistence use areas compared to historic use areas, including certain changes brought about by establishment of GAAR (SRB&A 2016a; Watson 2018). As noted above, even if certain traditional land use areas are not depicted on contemporary subsistence use area maps, communities maintain cultural ties to traditional use areas, and the protection of these areas is key to maintaining cultural identity and the ability to adapt to future changes. Koyukuk River region use areas for all communities overlap with various portions of the project alternatives.

According to ADF&G, subsistence use areas for the Tanana River region study communities (Tanana, Manley Hot Springs, Minto, Nenana) are focused around the Tanana River, Yukon River, Nenana River, and Minto Flats (see Appendix L, Maps 20 through 23). For road-connected communities (e.g., Manley Hot Springs, Minto, Nenana) use areas also occur along the Parks, Elliott, Steese, and/or Dalton highways. In the case of Nenana, documented use areas occur as far west as the Koyukuk River. Tanana use areas overlap with the southern portion of the project area.

According to ADF&G, subsistence use areas for the Yukon River region study communities (Stevens Village, Rampart, Galena, Beaver) are focused around the Yukon River system, extending from the Chalkyitsik area to the mouth of the Koyukuk River, in addition to along the Koyukuk River toward Alternative C near Hughes (see Appendix L, Maps 24 through 27). A majority of use areas for the Yukon River region study communities are located to the east and south of the proposed project alternatives.

Timing of Subsistence Activities

Data on the timing of subsistence activities are available for all 27 subsistence study communities. The seasonal round of subsistence activities is similar with some variation by community and region. Across all regions, spring was traditionally centered around muskrat and waterfowl hunting at spring camps and preparation for the busy salmon harvesting season (YRDFA 2008). While residents no longer use spring muskrat camps regularly, some hunting of muskrats and beaver continues to occur, and waterfowl hunting remains an important spring activity (Braem et al. 2015). When available, residents may hunt WAH during their spring migration north. Spring carnivals are important regional events, particularly for Kobuk and Koyukuk river communities, which center on the harvest and sharing of subsistence foods (Watson 2018). In summer, residents set nets for salmon, sometimes while staying at traditional fish camps, with

vegetation harvesting and large land mammal hunting also occurring during this time. Harvesting of sheefish during their summer runs is a key summer activity for Kobuk River communities. Large land mammal hunting begins in summer but peaks during fall, when residents hunt for caribou, moose, bear, and Dall sheep. Residents also hunt waterfowl in fall as they migrate south (Betts 1997). In fall, non-salmon fish (e.g., grayling, whitefish) replace salmon as the primary fish resource, with target species varying by community and region (Betts 1997; Marcotte and Haynes 1985; YRDFA 2008). Fall is also an important time for berry picking. Hunting and fishing (through the ice) continues at somewhat lower levels into winter. Residents may harvest moose for potlatches during winter, and some individuals also trap and hunt for beaver and other furbearers (e.g., wolf, wolverine, lynx, marten, fox) in winter. When caribou migrate into the region during winter, hunters from the Kobuk and Koyukuk river regions may travel by snowmobile—sometimes great distances—to harvest them (Watson 2018). Residents also harvest ptarmigan during winter when available.

Harvest Data

Appendix F, Table 24, provides average harvest and participation data for all resources for the 27 subsistence study communities, Appendix F, Table 25, provides average moose harvest and participation data for the 27 subsistence study communities, and Appendix F, Table 26, provides average caribou use and harvest data for the 42 caribou study communities. Use of subsistence resources among the study communities is high. On average, between 96 and 100 percent of households in the study communities report using subsistence resources on an annual basis, and between 75 and 100 percent of households report participating in subsistence activities (i.e., attempting to harvest 1 or more subsistence resources). On average, subsistence study communities harvest 576 pounds of subsistence resources (in terms of edible pounds) per capita annually. The highest average harvest is in Tanana (2,157 pounds), followed by Huslia (1,082 pounds), Fort Yukon (999 pounds), and Hughes (926 pounds). Regarding percentage of overall harvest, large land mammals and salmon are the top resource harvested in 12 study communities. Non-salmon fish is the top harvested resource in 2 study communities (Selawik and Noorvik). In general, large land mammals, salmon, and non-salmon fish comprise the top 3 resource categories harvested by most of the study communities, although marine mammals, migratory birds, vegetation, and upland game birds also appear among the top resources for some study communities.

Moose is a key large land mammal resource among many of the study communities and therefore species-specific data are provided in Appendix F, Table 25. On average, between 25 and 100 percent of the subsistence study communities report using moose (64 percent of households across all communities). Nearly half of households report attempting to harvest moose. Moose harvests account for up to 51.5 percent of subsistence harvests in the study communities and provide between 7 and 198 pounds per capita, on average. Communities harvesting the most moose per capita (over 100 pounds annually) include Rampart, Tanana, Galena, Alatna, Hughes, Wiseman, and Huslia. Data on use and harvests of caribou are provided in the following section.

Harvest amounts are dependent on the availability and abundance of subsistence resources within a community's subsistence land use area and are not necessarily reflective of a community's dependence on or preference for a given resource. In prehistoric times, when the Athabascans and Iñupiat of the area lived semi-nomadic lifestyles, the response to a decline in resource availability may have been to move to a more suitable location. With today's communities established in permanent locations, relocating to a more productive area, at least on a permanent or semi-permanent basis, is not an option for most individuals. Currently, communities have adapted to the availability of resources within their subsistence use areas, and when 1 resource declines, residents may increase their harvest of a different resource in response. An example of this is the declining harvests of caribou within the Upper Koyukuk Region and corresponding increase in moose harvests starting in the late twentieth century. This shift in harvests was in response to changes in the distribution of caribou away from traditional land use areas, and the gradual

appearance of moose within those areas. Other recent trends within the region observed by local residents and wildlife biologists include declining chum salmon and Chinook salmon runs; changes in the distribution of the WAH and reduced availability for certain communities; and recent declines in the availability of moose in the Upper Koyukuk region, with increased availability in the Kobuk River region (Braem et al. 2015; Watson 2018).

Subsistence Uses of the Western Arctic Herd

Appendix F, Table 26, provides caribou use and harvest averages across all available study years for the 42 caribou study communities listed in Appendix F, Table 23, and depicted on Volume 4, Map 3-32. The tables and maps provide context and extent of potential impacts associated with the road alternatives. The 42 caribou study communities are members of the WAH WG and are subsistence users of the WAH. Caribou is a key subsistence resource for many of the WAH WG study communities. Although caribou herd populations tend to fluctuate, the WAH population has declined precipitously in recent years. Recent censuses estimated the herd's population at 188,000 caribou in 2021 and 164,000 caribou in 2022, its lowest point in decades and below the WAH WG's minimum objective of 200,000 caribou (WAH WG 2022; see Section 3.3.4, Mammals). Herd declines over the last several decades have been attributed to declines in lichen cover and severe winter weather events resulting in high mortality (see Section 3.3.4, Mammals).

Of particular concern to wildlife managers is a decrease in calving and cow survival rates. As a result, the WAH WG changed the herd management level from "conservative" to "preservative," recommending limits on cow harvests and no harvests of calves (WAH WG 2022). In 2022, the Federal Subsistence Board approved a special action to close some federal public lands in Units 23 and 26A (the project is in Unit 23) to moose and caribou hunting by non-federally qualified users for the 2022–2024 hunting seasons. This was in response to a request by the WAH WG resulting from concerns about the recent WAH population decline (Federal Subsistence Management Program 2022). During recent RAC meetings in both the Northwest Arctic and Western Interior Alaska regions, board members have expressed concerns about the availability of caribou, indicating that their migrations are less predictable and the herds are more scattered (Northwest Arctic Subsistence RAC 2023; Western Interior Alaska Subsistence RAC 2022a). These concerns are particularly prevalent in the Northwest Arctic region. As 1 board member observed, the changes in caribou availability have had substantial social and economic effects:

> I have a lot of concerns regarding caribou. We know that they don't come through here anymore. I haven't gotten any fresh caribou meat within well over a year. It is a big concern. You know, our grocery stores here in Kotzebue, the shelves are bare, man, I mean they get hit hard.... You know this Pandemic has really hit us hard, this winter has really hit us hard with all these storms. And I could just see how it would be in the villages. It's probably three times worse. You know I see pallets daily going to the villages. I'm pretty sure they're going through a very hard time.... And I know a lot of people, you know, like going out there and pooling their money together and, you know, putting all their fuel and their gas and grub into one boat, you know, with four hunters to go up and try to get caribou for themselves and, man, there's times when they come back with nothing. You know it's beginning to get, in a way, if someone told me this is beginning to get depressing because people aren't filling their freezers.

With few exceptions, use of caribou among the 42 study communities is high, with more than 50 percent of households in 30 of the 42 study communities using caribou. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass, White Pass, Ambler, Shungnak, Deering, Koyuk, Noatak, and Buckland. Caribou contributes an average of at least one-third of the total harvest in those communities. Sharing of caribou is common, based on who is successful in a hunt and who is in need at any given time, and is part of the culture. Caribou sharing ranges widely, with

between 2 and 71 percent of WAH WG households giving caribou, and between 3 and 84 percent receiving caribou (the same households give at some times and receive at other times). On average, caribou contribute approximately 25 percent toward the total harvest for the study communities. Nearly half of households (48 percent) participate in caribou hunting, and residents harvest an average of 101 pounds of caribou annually (see Appendix F, Table 26). Some of the caribou study communities with the highest average per capita harvests are those with use areas overlapping or close to the project area: Ambler, Buckland, Shungnak, Anaktuvuk Pass, Noorvik, Selawik, Noatak, and Kiana. Other caribou study communities with high average per capita harvests (over 100 pounds) are Kobuk, Kivalina, Deering, Wainwright, Atqasuk, Nuiqsut, Point Lay, and Koyuk. Several of these communities, including Anaktuvuk Pass and Nuiqsut, rely more heavily on other caribou herds such as the Teshekpuk Herd and CAH.

While harvest data are only available for a limited number of study years for each community and therefore may not capture wide variations in annual harvests, review of individual study years suggest declining caribou harvests in several study communities: Elim, Kivalina, Kobuk, Kotzebue, Noatak, Selawik, and Shungnak. Thus, a number of study communities in the western portion of the project area may have experienced declines in caribou harvests in recent years. In contrast, several communities have seen a recent increase in caribou harvests in recent years, including Allakaket, Ambler, Deering, Hughes (based on 2 data points), Shishmaref, and Wainwright (based on 2 data points). While some communities' subsistence data indicate a trend of declining harvests, a reduction in harvests amounts does not necessarily equate to a reduction in resource dependence. Harvest declines could be a result of changes which are out of a community's control, such as the availability of caribou within communities' traditional harvesting areas; ability to access caribou herds due to increasing gas prices; and changes in the timing of the fall caribou migration (Watson 2018). Many communities that are located within the current "peripheral" range of the WAH were established in their present-day locations because of their proximity to key subsistence resources, including caribou. Many subsistence users report that caribou migration changed with the introduction of roads (e.g., DMTS road) and pipelines (TAPS pipeline), resulting in reduced availability of the resource within their traditional hunting areas (Alatna Tribal Council 2022; Western Interior Alaska Subsistence RAC 2022a). Other changes in caribou distribution have occurred over time. In recent years, the winter range of the WAH has shifted from the primary range of the Nulato Hills toward the Seward Peninsula; even more recently, a large portion of the WAH has wintered in the Brooks Range. Subsistence-based communities are vulnerable to even small changes in resource distribution as these changes may have large impacts on residents' ability to access hunting grounds. During population lows, caribou tend to inhabit their core range, thus limiting their availability to communities whose use areas overlap with the peripheral range of a herd.

The centralization of previously semi-nomadic peoples reduced their ability to adapt to the changing distribution and migration patterns of the WAH and other caribou herds. Without the means (e.g., transportation, funds) to access caribou herds, communities rely on sharing networks for their dependence on caribou and may shift their resource focus to other resources which are more available, such as moose. This does not mean that caribou is no longer culturally important to these communities, and if migration or distribution of the herds change in the future such that they are available, communities would likely resume previous levels of harvesting. Strong sharing networks between communities and regions ensure that residents of all study communities continue to receive and consume caribou, and the resource remains culturally important to these study communities regardless of current harvest levels. Sharing activities strengthen and affirm kinship and social ties and are integral to maintaining the cultural identity of subsistence users.

Downstream Subsistence Uses of Fish

Appendix F, Table 27, provides Chinook salmon, chum salmon, and sheefish use and harvest averages across all available study years for the 32 fish study communities listed in Appendix F, Table 23, and depicted on Volume 4, Map 3-32. The 32 fish study communities are located downstream from tributaries crossed by the project and include 6 communities in the Kobuk-Selawik River basin, 7 communities in the Koyukuk River basin, and 19 communities in the Yukon River basin. As discussed above (see Section 3.3.2, Fish and Aquatics), several species (Chinook salmon, chum salmon, and sheefish) have key spawning grounds in the project area and are therefore vulnerable to downstream impacts from the project. Sheefish in particular require specialized spawning habitat, and the upper Kobuk River supports the largest spawning population in the northwest region of Alaska.. All 3 of these species are key subsistence species throughout the region. Key spawning drainages for salmon include Henshaw Creek, Tozitna River, Indian River, South Fork Koyukuk River, and Hogatza River (including Clear and Caribou creeks and the Klikhtentotzna River) (see Section 3.3.2, Fish and Aquatics). Key spawning drainages for sheefish are the upper Kobuk and Alatna rivers (see Section 3.3.2, Fish and Aquatics). Other species which may occur in the project area and could be affected by the project include other species of whitefish (broad whitefish, humpback whitefish), Arctic grayling, burbot, northern pike, and Alaskan blackfish. Both anadramous and resident fish migrate seasonally between main river/stream channels and their tributaries; maintaining seasonal connectivity between these waterways is of critical importance to fish species (see Section 3.3.2, Fish and Aquatics). This section focuses on 3 species (Chinook salmon, chum salmon, and sheefish) of particular concern.

With few exceptions, use of fish among the 32 study communities is high, with more than 50 percent of households in nearly all fish study communities using Chinook salmon, chum salmon, or sheefish. The contribution of Chinook salmon toward the total subsistence harvest is highest in the Yukon River communities of Kaltag, Anvik, Nulato, Ruby, Marshall, Russian Mission, and Grayling (more than 20 percent of the total harvest). In these and several other communities, at least 50 percent of households participate in harvesting Chinook salmon. The reliance on Chinook salmon is somewhat more limited in communities on the Koyukuk and Kobuk-Selawik river drainages; however, in many of these communities, a substantial percentage of households receive Chinook salmon from other households (see Appendix F, Table 27).

Compared to Chinook salmon, chum salmon is more widely harvested across the study region. In nearly half of the fish study communities (for which data are available), chum salmon account for an average of 20 percent or more of the annual subsistence harvest. In 2 communities (Tanana and Hughes), chum salmon harvests contribute over half of the communities' subsistence harvest, on average. In 9 of the 32 fish study communities, at least half of the households participate in chum salmon harvesting. Again, sharing of chum salmon is high across the region, with an average of 39 percent of households receiving chum salmon (see Appendix F, Table 27).

While typically not harvested in the same numbers as salmon, sheefish are still a key resource in the study region, contributing an average of over 10 percent of the harvest in 6 of the 32 fish study communities (Kobuk, Noorvik, Kotzebue, Kotlik, Allakaket, and Shungnak). While sheefish are important to communities in the Kobuk-Selawik river system, communities on the Koyukuk (Alatna, Allakaket) and Yukon (Kotlik, Nunam Iqua, Emmonak, Alakanuk) river drainages also harvest substantial quantities of this resource. Participation in whitefish harvesting is high, with over 50 percent of households in nearly half of the fish study communities attempting harvests of the resource. On average across all fish study communities, 33 percent of households receive sheefish annually (see Appendix F, Table 27).

Chinook and chum salmon returns in northwest Alaska, including along the Kobuk, Koyukuk, and Yukon rivers, have declined since the 1990s, and the ADF&G considers Chinook salmon a "stock of yield

concern" (see Section 3.3.2, Fish and Aquatics). This listing is likely to change to a "stock of management concern" or "stock of conservation concern" as the Chinook populations have continued to decline since publication of the Final EIS. Since publication of the Final EIS, there have also been drastic declines in coho salmon. The declines in salmon have led to subsistence closures in the Yukon River drainages watershed (see Section 3.3.2, Fish and Aquatics). Finally, the average body size of all salmon species in Alaska has declined since 2010 (Oke et al. 2020); if these trends continue, subsistence users may require greater numbers of harvested salmon to meet their subsistence and nutritional needs. As salmon harvests have declined, some communities' harvests have shifted to more non-salmon fish harvests, particular harvests of sheefish and other whitefish (Alatna Tribal Council 2022; Braem et al. 2015; Watson 2018). The decline in salmon has affected the subsistence economies of many communities in the study region, including a decline in the use of fish camps, increased expenses and effort associated with salmon fishing, and a greater reliance on other fish species as well as sharing and bartering networks (Brown and Godduhn 2015). In the lower Yukon River basin, there was an increase in harvests of chum salmon due to restrictions on Chinook salmon harvests (see Section 3.3.2, Fish and Aquatics); however, in recent years, there have been restrictions on summer and fall chum salmon as run strengths have declined. An Allakaket resident and member of the Western Interior Alaska Subsistence RAC described the lack of salmon in recent years and expressed concerns about the impacts to other key fish species:

> Yeah, we never had salmon running for few years and it's getting worse. First it was king salmon crash and we were restricted to fish and then a couple years ago there was chum salmon decline and now last year there was no fishing except for small fish nets and the people around here are getting concerned about no fish. People hardly even go to fish camp around here anymore. Like when king salmon season was closed they – king salmon is the main fish diet for people up and down the river and you can't fish for king salmon so they don't fish at all. So it's kind of hard time with no fish. We're depending kind of heavily on the whitefish and sheefish and I'm getting kind of worried that we don't want to deplete those sheefish and whitefish also – whitefish is pretty good fish too but not as good as king salmon. (Western Interior Alaska Subsistence RAC 2022a).

Environmental Consequences

Road Impacts

The following sections describe the potential impacts of the proposed road to subsistence uses and resources. Further discussion of potential impacts resulting from the project is provided in the Subsistence Technical Report (see Appendix L) and the ANILCA Section 810 Final Evaluation (see Appendix M). A summary of community use areas crossing each alternative is provided in Appendix F, Table 28, and a list of communities and the type of impact appears in Table 29. These tables help to define the likelihood and magnitude of impacts and give a sense of extent as well. Resource-specific data for the subsistence study communities are provided in Appendix L. Based on these data, the project crosses subsistence use areas for 16 subsistence study communities (Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, Tanana, Wiseman). Subsistence use areas are most commonly crossed for small land mammals (15 communities), caribou and moose (12 communities each), and non-salmon fish and vegetation (10 communities each). Most of these resources (moose, caribou, vegetation, non-salmon fish) are of high importance to a majority of the potentially affected communities. In the case of small land mammals, these resources are generally of low to moderate resource importance to the study communities (see Appendix L). While trapping and hunting of furbearers and small land mammals occur among a smaller subset of community harvesters and provide a minimal amount in terms of subsistence foods, these activities are an important component of the local economy and culture, and furbearer harvesters often expend considerable time, money, and effort in their pursuits. The study communities with the highest numbers of resource uses crossed by the

proposed project alternatives are Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, and Evansville (8 or more resources out of 14 resource categories).

Project intersection is less relevant to determining indirect and downstream impacts on subsistence uses of caribou and fish. Instead, the relative importance of these resources to individual communities is most relevant to the likelihood and magnitude of these impacts. Data on resource importance for the caribou and fish study communities are provided in Appendix F, Tables 30 and 31. In 27 of the 42 caribou study communities, caribou is a resource of high importance (see Appendix, Table 30); data were not available for 4 study communities. Communities where caribou is of moderate resource importance based on selected material and cultural indicators include Bettles, Brevig Mission, Hughes, Huslia, and Teller. Communities where caribou is of low resource importance based on selected material and cultural indicators are Galena, Kaltag, Kotlik, Nulato, Stebbins, and Wales (see Appendix, F, Table 30). The communities that would be most likely to experience the effects of a decline in caribou abundance or a change in caribou distribution or health are those for whom the resource is of high importance. However, the other communities may still experience impacts if they have traditional uses of the herd or participate in sharing networks with the affected communities.

For fish, most (24 out of 32) fish study communities have a high material and cultural reliance on 1 or more of the 3 key species of Chinook salmon, chum salmon, and sheefish (see Appendix F, Table 31). Data are not available for 3 communities, and for the remaining communities (Alakanuk, Bettles, Evansville, Holy Cross, and Kotlik), these resources are of moderate importance. Communities most reliant on sheefish (high resource importance) include those in the Kobuk (Ambler, Kiana, Kobuk, and Noorvik) and Yukon (Grayling and Nunam Iqua) river basins. Communities most reliant on Chinook salmon include those in the Yukon River basin (Anvik, Emmonak, Grayling, Kaltag, Marshall, Nulato, Ruby, and Russian Mission), and Shungnak in the Kobuk-Selawik River basin. Finally, a large number of communities have a high reliance on chum salmon, including communities in the Kobuk-Selawik, Koyukuk, and Yukon river basins (see Appendix F, Table 31). These communities would be most likely to experience the effects of a decline in fish abundance or a change in fish distribution or health if impacts extend outside the project area. However, the other communities harvest these resources (albeit at lower levels) and would likely also experience impacts.

No Action Alternative Impacts

Under the No Action Alternative, the BLM and/or other federal permitting agencies would not issue authorizations for the Ambler Road; therefore, road construction and use would not occur. Air traffic to support mineral exploration would continue under the No Action Alternative and could cause deflection or disturbance of subsistence resources such as caribou. Heavy air traffic, particularly helicopter traffic, may reduce hunting success for subsistence users by causing skittish behavior in wildlife (Georgette and Loon 1988; SRB&A 2009b, 2018; Sullender 2017). As described in Appendix H (Section 2.3.3), there is also a slight potential for the continued lack of surface access to the District to reduce future interests in mineral exploration and associated air traffic. Most study communities would remain unconnected to the road system, and the road and associated large-scale mine development would not occur. Existing sources of impacts on subsistence for the study communities, including the Red Dog Mine, Dalton Highway traffic, air traffic, sport and non-local hunting competition, harvest and hunting regulations, and climate change, would continue to occur. Communities' traditional harvesting areas would remain largely untouched by industrial development thus minimizing impacts to cultural identity.

Impacts Common to All Action Alternatives

All action alternatives could impact subsistence resource abundance and availability as well as user access in the project study area. These impacts are discussed below. See also Appendices L and M for additional

discussion of project impacts to subsistence. In general, Appendix L, Maps 2 through 27, illustrate subsistence use areas for project area communities in relation to the road alternatives. These help to define the extent and likelihood of impact from any 1 alternative.

Resource Abundance

Construction activities that could affect resource abundance through removal or disturbance of spawning, foraging, and nesting habitat include blasting/mining, operation of construction equipment, excavation, placement of gravel, construction noise, human presence, water withdrawal, installation of bridges and culverts, placement of a winter construction access trail (e.g., ice roads, bridges, ice pads) during initial road construction, and air and ground traffic. Construction activities may also cause direct mortality to individual animals (e.g., caribou, fish, moose, waterfowl) through vehicle and aircraft collisions, pile driving, and blasting. The same types of effects would likely occur during reclamation of the road, camps, and airstrips, although at lower levels because the work at that time would occur principally on developed areas rather than on natural habitat. The timing and duration of construction activities are estimated in Appendix H, Table 2-9.

Operation activities that could affect resource abundance include the presence of roads and bridges (e.g., habitat fragmentation), the presence of other infrastructure (e.g., communications towers, culverts), fuel or other contaminant spills, dust deposition, road and air traffic, and human activity. The presence of the road in addition to related culverts, bridges, and gravel infrastructure would locally alter and impact fish habitat upstream and downstream from the road, which could affect fish abundance for subsistence users in certain waterways crossed by the road. It is not possible to predict the location and magnitude of such changes, although key sheefish spawning areas in the Kobuk River drainage and whitefish spawning areas in the Alatna River could be particularly vulnerable (see Section 3.3.2, Fish and Aquatics). During G2G consultation with Tribal councils in the Kobuk and Koyukuk regions, Tribal council members stressed the importance of particular drainages to the health and survival of salmon, sheefish, and other fish species such as grayling. These drainages include the Alatna, Mauneluk, Selby, and Kogoluktuk rivers and Helpmejack, Rocky Bottom, and Sinyalak creeks (Alatna Tribal Council 2022; Evansville Tribal Council 2022).

Habitat fragmentation resulting from sustained disturbances to caribou and other mammal and bird resources along the proposed road could result in decreased abundance of these resources over time. In the case of caribou, other Alaska herds such as the CAH have maintained habitat connectivity and general migration patterns despite being intersected by highways and roads. While the project represents a small proportion of the total WAH and RMH ranges, fragmentation of the ranges resulting from a road may be more pronounced because the WAH and RMH ranges have had less exposure to development infrastructure and activities than other herds such as the Teshekpuk Herd and CAH (see Section 3.3.4, Mammals). The likelihood of longer term impacts on resource abundance vary by resource and are discussed below under the individual alternatives, Indirect and Cumulative Impacts, and individual biological resources subsections in Section 3.3, Biological Resources. Appendix L includes additional information on longer term impacts.

As with construction, some direct mortalities would occur as a result of collisions with vehicles, aircraft, or infrastructure during operations. Individual mortalities of terrestrial mammals and birds would be most common under Phase 3 when traffic levels are highest. Collisions with caribou are most likely to occur within the western portion of the road corridors where caribou density is higher.

Ingestion of contaminated water or vegetation as a result of spills could also cause illness in individual animals. Residents from potentially affected communities noted how clear the water is in the project area, and expressed concerns that these pristine waters, which are used by some for drinking water, would

become contaminated (Alatna Tribal Council 2022). The health and safety of subsistence foods is a key concern for Indigenous residents, and Indigenous views regarding contamination may differ from Western science. For example, even if scientific studies show that contaminants are within a "safe range" for consumption, residents may still avoid harvesting subsistence foods that they perceive to be contaminated. Residents may perceive resources to be contaminated if their environment appears different (e.g., change in water color, dust on vegetation) or if there is a change in resource behavior (e.g., acting too comfortable around people or development activities) or taste. Indigenous residents in developed areas have reported changes in the taste of certain subsistence resources, such as caribou and fish (SRB&A 2009b). Thus, even if these resources are considered safe to eat by scientific standards, they may taste different or be considered of poor quality to Indigenous subsistence users.

Mines would use the road to transport fuel and other chemicals and toxic materials. Key sheefish, whitefish, and salmon spawning streams would be crossed by the proposed road corridors and therefore vulnerable to spills and other contamination include the Kobuk River, Alatna River, Henshaw Creek, South Fork Koyukuk River, and Hogatza River. Larger hazardous materials spills into waterways would have larger effects on fish habitat and abundance, particularly if spills occur in sheefish, whitefish, or salmon spawning streams, and could cause individual fish mortality, affect migration patterns, and affect fish populations. A large-scale spill could result in reduced harvests of aquatic resources in addition to marine resources, including marine mammals, farther downstream from the proposed road and mines, as a result of local harvesters concerns about contamination. In addition to spills, leaching of acid rock into waterways could affect aquatic habitat quality for sheefish, whitefish, Chinook and chum salmon, and other aquatic resources. Small changes in water quality could have substantial impacts on fish populations (see Section 3.3.2, Fish and Aquatics, regarding the low likelihood of large spills; see Section 3.2.3, Hazardous Waste, regarding spills in general). Such downstream effects could extend throughout the Kobuk-Selawik, Koyukuk, and Yukon river basins, affecting subsistence users from the 32 fish study communities (see Appendix F, Table 23).

Concerns about potential contamination of sheefish and chum salmon spawning grounds have already been voiced in the study communities (Watson 2014). During the scoping period for the original EIS, the traditional knowledge provided by the Native Village of Kotzebue indicated that silt and contaminants, as well as changes to water flows in the Kobuk River region watersheds, may lead to decreased health and abundance of sheefish, salmon, whitefish, and Dolly Varden char populations. The Native Village of Kotzebue commented that these resources are essential to the livelihood of the community, particularly due to the fact that they are inexpensive to harvest and are available throughout the year:

> Healthy and abundant sheefish and salmon require pristine watersheds free from silt and contaminants, in addition to sufficient water flows and unfettered access to the most remote parts of the Kobuk River for their annual spawning runs. Salmon are critical to our members, representing a major source of income and subsistence resources necessary for their continued quality of life and livelihood. Sheefish are a major part of the annual cycle of subsistence for our members as they are commonly harvested near Kotzebue for the majority of the year. They somewhat uniquely represent an egalitarian resource, in that they are easily harvested for much of the year by the entire community because of their proximity and without requiring scarce, or expensive, methods and means. Whitefish that feed in the summer in coastal lagoons of Kotzebue Sound and continue to be harvested as a treasured food by our members, also use the Kobuk River and its tributaries for spawning and overwintering purposes, as do Dolly Varden char. (Native Village of Kotzebue 2018)

The Kobuk River supports the largest population of spawning sheefish in Alaska, and the Alatna River is the only spawning habitat for sheefish in the upper Koyukuk River drainage. In addition, sheefish

spawning grounds are particularly sensitive to changes in water velocity, temperature, pH, and other factors. Salmon spawning habitat is also vulnerable in changes to water chemistry. A member of the Western Interior Alaska Subsistence RAC provided the following observations about water quality, salmon spawning, and the importance of smaller clearwater tributaries:

> All my life I never did catch a fish in the silt water at all. So it's something to think about. I hope they think about it because you come in here and older Natives that are alive right now they always say they don't know what they're talking about. For them to be 70, 80 years, they know what they're talking about. They never did catch a salmon in those silt water places. It's all flats, so there's no drainages that run up into the mountains. Once you start going into elevation, that's where you're going to find your salmon. (Western Interior Alaska Subsistence RAC 2022b)

Changes to natural water chemistry resulting from exposure of geologic materials could affect egg survival and fish populations, having far-reaching effects on downstream subsistence users of whitefish and salmon. As discussed in Section 3.4.7.1.5, Downstream Subsistence Uses of Fish, Chinook and chum salmon returns have declined in recent years, increasing the reliance of some communities on harvests of non-salmon fish (e.g., sheefish). Thus, the study communities would be particularly vulnerable to additional changes in salmon and non-salmon fish abundance. Impacts related to changes in Chinook salmon abundance would be most likely among Yukon River study communities, while impacts related to changes in sheefish abundance would be most likely among Kobuk River communities. Chum salmon impacts would affect communities in all 3 river basins (Kobuk-Seward, Koyukuk, and Yukon) (see Appendix F, Table 31).

Fugitive dust along the road would also result in loss or alteration of vegetation and wetlands along road corridors, which could affect feeding habitat for terrestrial mammals and birds and potentially cause individual mortalities. Of particular concern to caribou are declines in lichen cover along gravel roads as a result of dust deposition. For additional discussion of potential impacts to resource abundance resulting from operation, see Appendix L and Section 3.3, Biological Resources. See Section 3.2.3, Hazardous Waste, for a discussion of spills.

The process of reclamation would be a large scale construction-type process that would freshly disturb stream channels, create intermittent noise in a different pattern than standard road operations, and risk erosion and spills, any of which could temporarily affect resource abundance. However, once complete, the road corridor would be free of industrial activity, streams would be expected to find a new equilibrium, and over time the corridor would revegetate and become increasingly available as habitat. This would be largely dependent on what other actions may have affected the nearby habitat in the intervening years. The road's physical presence would act as a movement corridor for wildlife, including predators, during and well after reclamation.

Resource Availability

Many of the subsistence study communities have high unemployment rates, incomes below the poverty line, and high food insecurity (Guettabi et al. 2016). Despite these factors, community populations are stable. Subsistence activities and harvests are a key component in maintaining residents' ability to remain in their communities (Guettabi et al. 2016). Because of the importance of subsistence to maintaining the stability of the mixed economy and resilience of the study communities, these communities are also particularly vulnerable to impacts on subsistence harvests and subsistence resource availability.

As noted above, while the once semi-nomadic Athabascans and Iñupiat of the region once responded to resource declines by moving to more productive locations, today's residents live in permanent communities, and relocation is not an option for most individuals. Thus, residents adjust to resource

declines by increasing their harvests of other resources. A recent example of this is the decline in salmon runs in recent years, and the corresponding increase in harvests of other fish species. As the Alatna First Chief observed, "With the current salmon situation we have to start relying more and more on the local fishes" (Alatna Tribal Council 2022). In cases where the availability of multiple resources declines—in the case of a large-scale industrial or environmental disaster, for example—residents may be further stressed to adapt to the changes while also maintaining current cultural practices. Furthermore, many of the subsistence study communities do not currently have road access and most Alaska Native populations have specific cultural, social, and spiritual identities and needs that are inextricably linked to subsistence, which adds to vulnerability associated with change introduced through an industrial road. These communities are the most vulnerable to potential impacts to subsistence resource availability resulting from the project.

While certain local changes to resource movement or distribution may seem minimal from a biological perspective (i.e., not affecting overall population levels, body condition, herd ranges, etc.), local changes can have much larger impacts on resource availability to local hunters. It is important to a harvester's success that resources are available within traditional hunting areas at the expected time during the seasonal round, and that the resources are accessible via available forms of transportation. Small changes affecting animals can result in decreased hunting success due to a variety of factors. The Ambler Access Project Subsistence Advisory Committee (SAC) has identified several resources of particular concern to subsistence, including caribou, moose, salmon, and sheefish. SAC members have noted declines in the availability of some of these resources in recent years, including caribou, moose, and salmon (AIDEA 2022, 2023).

Construction activities that may affect resource availability for subsistence users include excavation, blasting, mining, ROW clearing, gravel placement, construction of a winter construction access trail (e.g., ice roads or snow trails), operation of construction equipment, general construction noise, human activity, vehicle and air traffic, sedimentation, and fuel or other contaminant spills. Many of these activities also would occur during road reclamation. Infrastructure such as the pioneer road; ice roads/snow trails; large, steep cuts and fills; temporary snow and material piles; material sites; culverts; and bridge piles may also pose physical obstructions for terrestrial mammals and fish. Impacts of infrastructure on resource availability are further discussed in Appendix L and below, under Operation. See also Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N for design features and potential mitigation measures. The 16 communities that have use areas overlapped by project alternatives would experience direct impacts to resource availability. Larger impacts to resource behavior, migration, or distribution could result in indirect impacts to resource availability for all 27 subsistence study communities, the 42 caribou study communities, and the 32 fish study communities. Impacts to individual study communities are discussed in more detail in Appendix L and presented in Subsistence tables in Appendix F.

In the short term, blasting and clearing may displace or divert subsistence resources such as large and small land mammals and waterfowl due to the noise associated with such activities. These activities would also impact vegetation and surrounding habitat for subsistence resources such as caribou, moose, and waterfowl, and would remove berry, wild plant, and wood harvesting areas for study communities along the road corridor. Clearing of trees and brush for the ROW and stripping of topsoil and organic material may alter or degrade resource habitat, particularly for herbivores that depend on surface vegetation or for fish in streams or rivers affected by erosion, sedimentation, and contamination.

Habitat alteration can affect resource distribution, thereby reducing the availability of those resources to subsistence users in traditional hunting or harvesting areas. Construction of the action alternatives would result in direct habitat loss for WAH caribou. A reduction in lichen-dominated vegetation would have greater impacts to the WAH as lichen is a particularly important food source to the WAH. Low

abundance of winter forage may result in caribou migrating farther in search of suitable habitat, increasing energy expenditures and making the resource more vulnerable to predation (see Section 3.3.4, Mammals). One member of the Northwest Arctic Subsistence RAC (2023) noted how forage availability has long-term effects on caribou migration:

> They can't migrate in the same area years and years because they eat up all that food and it takes so long for the lichen to grow that the caribou won't come to there.

The action alternatives would result in removal of habitat in the winter, migratory, and peripheral ranges of the WAH. Loss of winter habitat would be particularly detrimental to the WAH as winter foraging can be limited (see Section 3.3.4, Mammals). A member of the Northwest Arctic Subsistence RAC noted that in recent years, climate change has made winter foraging even more difficult for the caribou herds:

> This climate change in the past maybe five, six years and knowing the caribou and stuff, after it snows in November we usually get rain and when it snows, that rain it'll freeze on top of the tundra and the caribou are having hard time feeding so – and we lose a lot of caribou due to starvation due to this climate change, so people out there need to be aware of that because a lot of people will wonder why are we losing so much caribou. So this climate change did lots of damage on our subsistence take on caribou.... And the people should know that it affects the herd. (Northwest Arctic Subsistence RAC 2022)

If loss of foraging lands results in the WAH changing its distribution in search of more suitable habitat, then local communities could experience reduced hunting success or have to travel farther to locate caribou.

Fish may experience direct mortality through driving of bridge pile, and certain activities, such as pile driving, construction sedimentation, and stream diversions, may alter or degrade fish habitat thereby reducing egg survival downstream. Construction of ice roads and pads would require water withdrawals from lakes and rivers near construction activity. Water withdrawal would be limited to 15 percent in waterbodies with sensitive fish species such as salmon and whitefish. Water withdrawal may kill individual fish but would likely not have population-level effects, as ADF&G's fish habitat permits include requirements for water intakes to avoid fish injury (see Section 3.3.2, Fish and Aquatics). Water withdrawals for ice roads would alter water quality and water flows and could potentially affect fish habitat, although these impacts are expected to be temporary and short term. Runoff from melting ice roads and pads could also have temporary effects on water quality.

Noise from construction equipment, gravel placement, blasting, mining, vehicle traffic, aircraft and helicopters, and human activity would likely displace or divert subsistence resources such as caribou, moose, bear, small land mammals, and waterfowl. Traffic itself causes a physical barrier for migratory animals, particularly caribou, and could also displace or divert resources when herds are separated (Vistnes and Nellemann 2007). Potential effects of construction activities on resource availability also include contamination resulting from fuel and other chemical spills, dust deposition, sedimentation due to erosion along river and stream banks, and increased emissions. Construction activity may lead to concerns by local residents about contamination of subsistence resources, particularly plants and berries, which are of high importance to nearly all potentially affected communities and which could be directly affected by fugitive dust along the road corridors. This concern would be especially elevated in areas where NOA is exposed during construction or contained in the gravel fills used for the project. Fuel spills and erosion may also result in contamination of waterways, affecting fish and other animals who ingest contaminated water. Contamination or perceived contamination can have indirect effects on subsistence, as subsistence users may reduce their consumption of a resource if they fear contamination; therefore, resources

perceived as unhealthy or contaminated are considered unavailable to local residents. This response has been systematically documented in household harvest surveys and hunter interviews on the North Slope of Alaska, with between 22 and 54 percent of respondents indicating that they had avoided eating certain subsistence foods in the previous year because of concerns about contamination. The communities with the highest rates of avoidance are also those closest to major oil and gas developments on the North Slope (SRB&A 2017, 2018).

This analysis assumes no road users authorized by AIDEA (e.g., construction workers, vehicle operators) would be allowed to hunt or fish from project facilities, the potential for impacts to resource availability resulting from hunting or fishing by construction workers is a key concern that has been raised by the study communities. Potential mitigation measures presented in Appendix N (Sections 3.4.7, Subsistence Uses and Resources, and 3.4.3, Recreation and Tourism) include a measure to disallow hunting and fishing by employees; the BLM would have the authority to enforce such restrictions on BLM-managed lands only, however. AIDEA could adopt this measure as an overall design feature of its own, and it would then apply throughout the length of the project. Public access to the area by the general public and project workers for hunting or fishing via the proposed road would not be allowed. It is possible that once the area is known to more people (e.g., workers on their own time, via airplane, OHV, or snowmobile, but not via the road), they may visit the area and access public lands to engage in harvesting activities, which could increase the number of hunters in the area over time and reduce resource availability for local residents. The ROW may also result in unauthorized access by local and non-local hunters. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, includes design features to monitor road activity and staff gates around the clock to minimize such use.

See Appendix L for more detailed discussions of potential impacts to the availability of caribou, moose, fish, and vegetation to the study communities.

Disturbance, displacement, or contamination of subsistence resources during operations could result in those resources being unavailable at the time and place that local harvesters are accustomed to finding them. In general, impacts would be similar to the construction impacts (discussed above) pertaining to traffic, dust deposition, human activity, contamination, and infrastructure. However, the impacts would occur over a longer period and would occur with either greater or lesser frequency or intensity depending on the impact source. Under Phase 3, the final road would be larger and access roads and maintenance stations would be in place; therefore, infrastructure-related impacts on resource availability during operations would be more likely than during construction. Overall, decreased availability of resources resulting from project operations may result in residents having to travel farther to access subsistence resources, with greater risks to safety and greater expenditures of time, effort, and money.

Sources of noise from maintenance and operation of the road would include vehicle traffic, small fixed-wing aircraft, helicopters, maintenance equipment and activities (e.g., backup horns, rock crushing, grading, sanding, plowing, gravel placement), and human activity. The frequency of truck traffic would increase over the 3 project phases, and would be higher once mine exploration and development began, with 104 to 168 trips per day during peak mine production (see Appendix H, Table 2-6). Increased traffic along the Dalton Highway may also displace caribou from the HHH, affecting resource availability to users of that herd, although documented use of the herd by local residents is limited. While the road under Phase 2 would be a single-lane road and traffic would occur in 1-way convoys, the road would be upgraded to a 2-lane road under Phase 3 and traffic would not occur in convoys.

All of the action alternatives overlap with fall migration routes near Kobuk; fall migration routes have become more concentrated to the southwest as winter distribution has shifted toward this area. Avoidance of development areas are most common in caribou during the calving season but can occur at other times

as well. On the North Slope, caribou have been found to reduce their use of habitat within 3.1 miles of development during the calving season, and 1.2 miles during the post-calving season. "Active infrastructure" (e.g., roads with traffic rather than just the roads themselves) may cause more avoidance behavior (see Section 3.3.4, Mammals). Roads and road traffic are believed to cause behavioral and migratory changes in caribou which can affect hunting success. Deflections or delays of caribou movement from roads and associated ground traffic and human activity have been documented in the traditional knowledge of harvesters (SRB&A 2009b, 2014, 2018) and during behavioral studies on caribou, particularly for maternal caribou (displacement of between 1.24 and 2.5 miles [2 and 4 kilometers] from roads) (ABR and SRB&A 2014). In recent years, reports of ground traffic–related impacts on the North Slope caribou hunting, particularly in the vicinity of Nuiqsut, have increased with the construction of gravel roads in the area (SRB&A 2016b, 2017, 2018). Impacts from roads have also been observed by Noatak and Kivalina caribou hunters in regard to the Red Dog DMTS (SRB&A 2014). Residents have observed that some caribou will stop once they reach the DMTS, sometimes traveling alongside the road before crossing, and other times bypassing the road altogether. As the chairman of the Western Interior Alaska Subsistence RAC stated at a February 2022 meeting,

> My comment would be that caribou are pretty afraid of the roads. It's graphic with GPS collars on caribou at the Red Dog Road. It's graphic on the Dalton Highway when the Porcupine Herd was unfamiliar with this road and came straight perpendicular to it. They kept moving back for four years. Finally they started to cross the road. Those roads really impeded caribou migrations. (Western Interior Alaska Subsistence RAC 2022)

As indicated in the above quote, such behavior has also been documented through radio collar observation. A study conducted by Wilson, Parrett, Joly, and Dau (2016) found that the DMTS influenced the movements of approximately 30 percent of radio collared WAH caribou, and of those individuals, the average delay in crossing was 33 days. Caribou from the Teshekpuk Herd were not similarly affected, which could be due to greater exposure of the Teshekpuk Herd to industrial development in the eastern portion of its range. In general, observed caribou behavior in response to the DMTS is variable: in some cases caribou cross seemingly without delay, while in other cases, herds scatter and migration is delayed for multiple days (ABR and SRB&A 2014; Wilson et al. 2016). Responses to roads also seem to vary from year to year based on the context in which roads are encountered, including the motivation of the caribou to cross (e.g., during mosquito and oestrid fly harassment seasons) (see Section 3.3.4, Mammals). Recent studies specific to the WAH show that current herd movements avoid existing roads.

Alaska Native entities present at the scoping meetings also described potential impacts to resource availability in traditional use areas. A majority of the traditional knowledge comments noted the potential for altered migration, particularly in regard to caribou as well as aquatic resources. The Western Interior Alaska Subsistence RAC noted that noise disturbances resulting from increased traffic would decrease availability of key terrestrial and aquatic resources within at least a 50-mile radius of the Project:

> The Council emphasizes that the impacts of developing the Ambler Road Project will have adverse and far-reaching effects within at least 50 miles of each side of the road. These impacts include noise disturbance to terrestrial and aquatic wildlife resulting from increased motorized off-road vehicle traffic and boat use extending up the coast and into the Kobuk River Drainage. The increased motorized off-road vehicle traffic and boat use resulting from development of the Ambler Road will also have significant adverse impacts up and down the Koyukuk River, John River, and Alatna River drainages. (Western Interior Alaska Subsistence RAC 2018)

The tendency for caribou to divert around areas of disturbance is evidenced by traditional hunting methods which are still observed today. According to WAHWG (2017), caribou hunting traditions ensure that caribou migratory paths are well established before hunting begins:

> Hunters in Kiana were instructed to wait two days after the first caribou passed through for the migration to be established. By waiting to harvest caribou, the community protected the migration for years to come.

Other traditions indicate that residents should camp and hunt on the south sides of rivers in the fall so that caribou cross these linear features before encountering hunters. This reduces the likelihood of further deflection away from the river and overall changes in migratory paths.

Air traffic has been a commonly reported and observed impact on caribou on the North Slope and in Northwest Alaska (SRB&A 2009b, 2018; Georgette and Loon 1988; Sullender 2017). Air traffic is observed to cause behavioral changes, skittish behavior, and delayed or diverted crossing behavior, which in turn has impacts on caribou hunting success for local hunters. These types of behaviors are most commonly observed in response to helicopter traffic, although fixed-wing aircraft have also been observed to elicit similar responses (Sullender 2017). In addition to changes in behavior, increased exposure to aircraft disturbance may also affect body condition through increased energy expenditures (e.g., more time fleeing versus feeding or resting) (Sullender 2017). Furthermore, increased energy expenditures may result in reduced foraging rates and, ultimately, decreased mating success/pregnancy rates.

Air traffic levels would be slightly lower under operation. While overall ground traffic would be higher during mine production, human activity would be lower once construction is complete. During road operations, the final 2-lane road combined with an increase in traffic would likely increase the potential for deflection or delay of caribou movements, particularly during the fall migration south (see above under Construction), a peak hunting time for the study communities. In other rural communities where roads have been built, access to private roads has in some way offset some of the impacts to resource availability; however, AIDEA's proposal would prohibit local public access along the road and this lack of access to local hunters would introduce subsistence impacts with no offsetting subsistence benefit.

In addition to causing physical obstructions to hunters and animals, oil and gas–related infrastructure would also cause visual disturbances. As noted in Section 3.4.4, Visual Resources, aside from the Dalton Highway and TAPS pipeline on the eastern periphery of the project area, most existing infrastructure in the project area is limited to small communities, camps, and cabins. Associated structures are generally small, made of natural materials, and/or of relatively natural coloring. Oil and gas-related infrastructure is more likely to stand out on the landscape and cause visual disturbances, resulting in changes in resource distribution and movement or avoidance by hunters. Visual disturbances may also cause residents to perceive the natural character of the landscape to be degraded, negatively affecting subsistence users' experience on the land.

In addition to visual disturbances, animals may also react to changes in smells across the landscape, including on the land, in water, and in the air. Animals use odor to determine where they go and to select feeding grounds and water sources (Finnerty et al. 2022; Nielsen et al. 2015). Changes in smells resulting from construction activities, vehicle emissions, introduction of new materials, and accidental spills could affect resource distribution and behavior, thus reducing their availability within traditional harvest areas.

The proposed road routes cross through community caribou hunting areas for 12 communities: Hughes, Kobuk, Shungnak, Allakaket, Ambler, Bettles, Evansville, Alatna, Huslia, Anaktuvuk Pass, Selawik, and

Tanana (see Appendix L, Table 45). For 7 of these communities, caribou are a resource of high importance, while for the remaining 5 communities, caribou are of moderate or low importance based on selected measures. While caribou are harvested in lesser quantities than in the past for some of the study communities, changes to subsistence uses of caribou are often a result of changes in caribou migration or distribution, which are out of a community's control. In many cases, communities were originally situated in areas known to be productive for caribou harvests, only to witness shifts in the distribution of the caribou herds which made them difficult to access. In more recent years, construction of TAPS and the Dalton Highway was reported by local residents to shift the distribution of caribou, and residents within the eastern portion of the proposed road corridors, such as Bettles, Alatna, and Allakaket, experienced a decline in harvests. Today, some residents from the northern and eastern portions of the project area travel to the southwest of the community toward Buckland into the WAH wintering grounds to harvest caribou. Without the means (e.g., transportation, funds) to access caribou herds, communities rely on sharing networks for their dependence on caribou and may shift their resource focus to other resources which are more available, such as moose. This does not mean that caribou is no longer culturally important to these communities, and if migration or distribution of the herds change in the future such that they are available, communities would likely resume previous levels of harvesting. In addition to the communities who have documented use of the proposed corridors, additional subsistence study communities and caribou study communities may experience impacts to caribou availability if the road causes larger impacts on caribou movement. Future changes in the distribution or migration of the caribou resulting from the road and other factors may result in changes to boundaries for the winter, migratory, and peripheral ranges of the herd, thus affecting the availability of the herd to communities in different ways.

Stream and riverbeds may experience increased sedimentation or alteration over time due to the presence of culverts and bridge piers. The impacts of erosion and beaver dams on salmon spawning grounds was a topic discussed during a recent meeting of the Northwest Arctic Subsistence RAC (2022b), highlighting the importance of access to spawning grounds:

> I think some of them creeks are dammed up, pretty much dammed with the beaver and that's one thing that's causing the fish not to come out, and no air and stuff like that happening statewide, it's not just happening here. But salmon spawning, man, I tell you the erosion that's happening and it's turning the river shallower, seems like, and I haven't gone up river for quite awhile it seems like the river's changed above – above Kobuk it's really changing.... But salmon spawning, oh, man, they're going to be lower and lower down this way for salmon spawning because getting pretty – a lot of dead salmon on the sides after spawning.

AIDEA has proposed to install crossings to protect natural flow patterns and minimize negative effects, and the BLM has proposed mitigation measure for fish that would require culvert inspection (see Appendix N). However, if culverts and bridges are not properly maintained or if erosion control measures are not taken, fish migrations could be disrupted or blocked, which could reduce fish availability for subsistence users (see Section 3.3.2, Fish and Aquatics). Ice roads and pads may also temporarily block fish passage if the compacted ice takes longer to melt. The risk of contamination from dust deposition and fuel would continue through the life of the project, and depending on the magnitude of spills could have far-reaching impacts on upstream and downstream subsistence users. Changes in the availability of fish species could affect subsistence users throughout the project area and downstream from the project area, particularly if the project results in changes in fish distribution or the timing of fish migrations. Subsistence users often harvest specific resources at specific times and places, and if these patterns are disrupted, they may experience declines in harvest success or have difficulty accessing traditional use areas when resources become available in those areas (e.g., if the fish arrive late and subsistence users cannot use boats to access them). At a meeting of the Northwest Arctic Subsistence RAC in November

2022, 1 board member noted the impact of changes in the timing of fish migrations on harvesting success in recent years:

> We are in a time right now that this weather, the climate change and when we're out in the springtime waiting for the whitefish to come out of the lakes and we're trying to put away and dry whitefish and it's cold. We don't have – maybe some days we'd have two to three warm days that would help dry our fish and stuff but with this climate change and stuff now we're missing the spawning whitefish and stuff going up the river. They're going up early and the water is so high all summer, all fall so most of us really didn't get a chance to get our whitefish and stuff.... that's what we really live on is the nice big (in Iñupiaq) they are called, the whitefish. And now everybody's having a hard time and it's continuing every year. We don't know when the fish are going to move. Springtime we usually have a – we know when they're supposed to be coming out. I missed pike, most of us did because we didn't even know when they came out of the lakes or anything. I didn't really get any pike to dry this spring. (Northwest Arctic Subsistence RAC 2022a)

Gravel mining and associated blasting would continue throughout operations for roadway maintenance; therefore, some individual loss or displacement of fish would continue during operations. The introduction of invasive plants along road corridors could impact resource habitat and/or productivity and impact the availability of certain resources, including wild edible plants and berries, to subsistence users (see Section 3.3.1, Vegetation and Wetlands). Invasive aquatic plants could also alter aquatic and wetland habitat and reduce the availability of fish and other resources in certain areas. Unlike other construction impacts that are expected to be more short-term, the introduction of invasive species could become a long-term impact if their spread is uncontrolled, potentially reducing plant and berry availability for subsistence users along the road corridors. However, Appendix N includes mitigation measures to help control and minimize the spread of NNIS.

Most of the restrictions to availability would cease once the road was fully reclaimed and closed. The noise and activity of the reclamation process itself, including the removal of bridges and culverts that would increase water turbidity, may displace animals and fish that are subsistence resources and make them unavailable. After closure was complete, and as stream channels settled into equilibrium and the corridor gradually revegetated, the corridor likely would become habitat for plants and animals. It is not clear that this would necessarily reestablish previous (year 2020) resource availability patterns, but a source of disturbance would be gone.

User Access

Fifteen of the 27 subsistence study communities have subsistence use areas crossing 1 or more of the proposed road corridor alternatives (see Appendix F, Table 29, which provides a sense of the likelihood and magnitude of potential impacts, and see Appendix L for further detail). These communities would be the most likely to experience direct impacts to user access resulting from the proposed road. Of these communities, 5 (Bettles, Evansville, Hughes, Kobuk, Shungnak) have use areas that are bisected by the road, meaning that access to a large portion of their hunting, fishing, and gathering areas would require crossing the road (depending on the chosen alternative). Alatna, Allakaket, Ambler, Coldfoot, Huslia, and Wiseman use areas are also crossed but to a lesser degree (i.e., the road intersects a portion rather than through the center of their use areas) than the above 5 communities. The remaining 4 communities in Appendix F, Table 29 (Anaktuvuk Pass, Selawik, Stevens Village, and Tanana) have use areas that are overlapped on the periphery by 1 or more of the road corridor alternatives and therefore harvesters in these communities could also experience direct impacts. Just because the road corridor does not bisect a community's subsistence use area does not mean that the community would not experience direct impacts or that the area crossed by the community is not an important one for subsistence. For example, while the

road corridor does not "bisect" the subsistence use areas for Alatna and Allakaket, the road crosses key subsistence use areas along the Alatna River which are used by both communities (Watson 2018).

The subsistence activities that most commonly occur near the proposed corridors include hunting and trapping of small land mammals and furbearers, hunting of moose and caribou, vegetation harvesting, non-salmon fish harvesting, and migratory bird hunting. Other resource harvesting activities that could be affected include other large land mammal (Dall sheep and bear) hunting, upland game bird hunting, salmon fishing, and to a lesser extent, egg harvesting.

Impacts to harvester access would occur near the road corridor, where harvesters could be faced with physical obstructions to access or be forced to avoid construction work areas. Construction infrastructure (e.g., the pioneer road, ice roads, construction laydown materials, heavy equipment) could present physical barriers to subsistence users. For example, hunters may not be able to cross over a high road on their snowmobiles, particularly if they are pulling a heavy load. In addition, individuals traveling overland may have to divert around material sites and other areas that are unsafe for travel. AIDEA has proposed working with subsistence users to provide crossing ramps to provide access to their subsistence resources (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA). Appendix N indicates that these ramps would be installed during Phase 1 construction. Hunters may not be allowed to cross construction-phase roads until crossing areas are established and hunters may not be allowed to cross during active construction activity, which would obstruct travel altogether for a short time. The timing and duration of construction activities are estimated in Appendix H, Table 2-9. It is anticipated that bridges would be designed with adequate clearance. However, it is possible that bridges may affect boat travel along certain smaller waterways or in unusually high or low water conditions; the likelihood of this impact depends on individual bridge height and design.

The degree of impacts from construction would depend on whether the timing of construction activities conflicts with subsistence use areas and activities for a community. Because construction would occur year-round, it is likely that there would be direct conflicts with construction activities for certain subsistence uses. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N contain measures to minimize impacts of construction. According to data collected for several communities whose use areas are bisected by the project alternatives (Hughes, Bettles, Evansville), in addition to several communities whose use areas overlap with portions of the project (Alatna, Allakaket, Wiseman/Coldfoot), residents of the region primarily use boats and snowmobiles to access hunting and gathering areas, although road-connected communities (Wiseman/Coldfoot) also commonly use road vehicles to access harvesting areas (see Appendix L; SRB&A 2016; Watson 2018). Subsistence activities occur year-round, peaking in fall (August and September) and again in mid-winter and early spring (February through April) for most study communities with available data. Overland trails, routes, and/or traplines would be bisected by the project. In these cases, residents may abandon or alter traplines to avoid regular crossing of the project corridor, including construction-phase roads and ice roads. Instead of using established community trails, some residents may reroute around the road system or simply use areas that require crossing the road less often. Travel routes, including portages and historic trails, have been identified by community members in the vicinity of the road corridor (Skinner 2023). Abandoning established trails could result in greater risk to hunter safety as they travel farther or on unfamiliar terrain to access subsistence harvesting areas. Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N include measures to minimize such impacts. The project corridors cross areas used for both riverine and overland travel (see Appendix L), and construction activities would occur year-round; therefore, residents may experience impacts from construction during all subsistence seasons and for all subsistence activities that are overlapped by the project.

In addition to bisecting trails and travel routes, the road corridor would also cross near community camps, such as traditional fish camps and hunting camps. If the road crosses too close to an existing camp, it is possible that subsistence users would abandon the camp altogether. Abandonment of camps due to their proximity to development has been documented on the North Slope for the community of Nuiqsut (SRB&A 2018). In the vicinity of the road corridor, camps have been identified along the John River, Koyukuk River, Alatna River, Malamute Fork of the Alatna River, and Kogoluktuk River (Skinner 2023).

In addition to physical barriers to subsistence users during construction, residents may also experience reduced access due to security restrictions around construction work areas or general avoidance of development areas. As stated in the Subsistence Technical Report (see Appendix L), regardless of regulatory and physical barriers in the project area, subsistence users may choose not to access nearby subsistence use areas any longer because construction-related sites, smells, lights, noises, and activities could disturb resources, reduce the potential for a successful harvest, and impact the harvester's experience. Residents may avoid hunting near the road due to concerns about shooting near infrastructure and human activity, lack of knowledge regarding security protocols, contamination concerns, and general discomfort with conducting traditional subsistence activities near non-local workers and industrial activity. In addition, shooting from or across a road is contrary to Alaska law. For additional discussion of potential avoidance related to the project, see Appendix L.

As noted above, 15 of the 27 subsistence study communities have subsistence use areas crossing 1 or more of the proposed road corridor alternatives, and the road and other project related infrastructure would represent a direct reduction of traditional subsistence hunting and harvesting areas for these communities. During road operation, residents would continue to experience physical barriers to access resulting from infrastructure such as roads, although the presence of crossing ramps would help reduce those impacts. Whether crossing ramps would reduce access impacts for local hunters would depend on the location, design, and frequency of the ramps. Because subsistence users do not always use or follow established trails when pursuing resources overland, instead traveling in various directions based on environmental factors (e.g., weather, snow, ice conditions) and traditional knowledge of resource distribution and behavior, the presence of crossing ramps would not completely mitigate impacts to user access. Subsistence users may have to travel additional distances when pursuing resources to locate approved crossing areas, or they may take safety risks by crossing in areas not approved for crossing. In addition, despite the presence of crossing ramps, some individuals may still have difficulty using crossing ramps, especially when hauling sleds. Subsistence users in the North Slope community of Nuiqsut have reported difficulty under certain conditions when using crossing ramps on industrial roads near their community (SRB&A 2018).

While road access for local subsistence users would not be allowed, it is possible that residents from nearby study communities in addition to non-local hunters from other regions would use the cleared ROW alongside the road as a travel corridor for overland (snowmobile or OHV) travel, particularly if resources such as moose concentrate in these corridors. AIDEA indicates that ROW travel would be prohibited, security would patrol the roads to prevent violations, and drivers would be in radio contact and would be required to report activities in the vicinity of the road. Road operators would be required to have an access plan, including access controls (see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N). Enforcement measures would reduce, but are not anticipated to stop, trespass use of the ROW. Restrictions on use of the ROW, particularly by local residents when certain areas of the road would be crossable, may be difficult to enforce. Increased non-local access would be less likely but may affect subsistence uses for residents of the subsistence study communities by increasing human activity and competition in the area. Competition from non-local hunters, facilitated by guiding and air charter services, is an existing source of impacts to subsistence users within the region. Sport hunting of the WAH has increased substantially since 2000, and conflicts between locals and sport hunters related to

aircraft disturbances are commonly reported (Fullman et al. 2017; see Section 3.3.4, Mammals). Residents have reported other actions from non-local hunters which are inconsistent with traditional Athabascan and Iñupiaq values, such as hunting for sport, wasting meat, hunting in key migration corridors, or targeting the "lead caribou" in a herd, thus deflecting them from their usual routes (Braem et al. 2015). A potential for increased access to the region and competition by outside hunters resulting from a road corridor and associated ROWs is a primary concern that has been voiced by a number of subsistence study communities (Watson 2014; BLM 2018a). It is reasonable to assume that there will be unauthorized public access along ROWs, particularly near where the road meets the main road system. While gate facilities would be placed at either (east and west) end of the road corridor, hunters approaching the corridor from the north or south may travel along the ROW without encountering security personnel. Unauthorized public access from non-local hunters would be more likely under Alternative C, which places the road closest to larger population centers. While the proposed road and airstrips would be closed to unauthorized public access, the magnitude of impacts related to competition would depend on the ability to control access along the proposed road alternatives and ROWs. See Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N for several related measures meant to control access. For additional discussion of potential use of the ROW by local and non-local hunters, see Appendix L.

During operations, harvester avoidance of the project area may be reduced from construction levels due to decreased noise and human activity disturbances, although avoidance responses would likely continue throughout the life of the project for certain individuals. The area of infrastructure-related avoidance by local residents would be larger during operations due to the greater infrastructure footprint. In addition, avoidance may extend to a larger area than the footprint if residents perceive that resources are less available in surrounding areas. Because the road corridor bisects subsistence use areas for 8 communities (Bettles, Evansville, Hughes, Kobuk, Shungnak, and to a lesser extent Alatna, Allakaket, Ambler, Coldfoot, Huslia, and Wiseman), residents from these communities may not have the option to avoid the road altogether to continue accessing traditional subsistence use areas. Therefore, total avoidance of the study area may be more likely for residents from communities whose use areas are on the periphery of the project area (e.g., Anaktuvuk Pass, Huslia, Kiana, Selawik, Stevens Village, Tanana). Delayed arrival of caribou and/or changed migration patterns due to the Ambler Road could also adversely impact harvests in these communities.

Regardless of alternative, AIDEA has a SAC made up of local residents from Alatna, Allakaket, Evansville, Hughes, Huslia, Kiana, Kobuk, Noorvik, and Shungnak. The purpose of the SAC is to provide meaningful input on road design, operations, and maintenance; identify potential impacts on subsistence resources; act as representatives for the affected communities, and communicate with AIDEA regarding subsistence issues (AIIDEA 2023). Similar committees have been established in other communities affected by road and other development; while useful for identifying and lessening impacts, the existence of these committees does not guarantee that suggested mitigation would be implemented or that impacts would be eliminated. AIDEA has also proposed allowing some commercial access to communities, which could result in increased access to and decreased costs of goods, such as food, fuel, and equipment. Decreased fuel costs could have a subsistence benefit by allowing residents to travel farther, more frequently, or at reduced cost in pursuit of subsistence resources. For additional details about AIDEA's design features and potential mitigation, see Chapter 2, Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N, Sections 3.4.2 (Transportation and Access) and 3.4.7 (Subsistence Uses and Resources). Potential mitigation measures also include timing project activities to avoid subsistence activities and, generally, not impeding subsistence. The potential measures are anticipated to be effective in minimizing impacts, but would not completely mitigate them.

Road reclamation after 50 years of operation would be a large-scale construction-type project that would result in noise and activity along the road corridor. Depending on timing of road work, removal of crossing ramps, and opening of the area to free-er travel, hunting access could be further restricted during a season or two. Overall, restrictions caused by the Ambler Road on movement of local community members across the landscape for subsistence purposes would be removed once the road was fully closed and the industrial activity had ceased. The abandoned road corridor would revert to management under then-current land management plans, and it is likely that subsistence communities would have full use of it. Some people may use the corridor as a way to access hunting, fishing, or gathering areas, but most of the road embankment and the bridges and culverts would be removed, so the new topography or open water crossings may restrict usefulness of the corridor to relatively short segments. AIDEA sponsorship of a subsistence working group would cease.

Sociocultural Impacts

Impacts to resource abundance, resource availability, and user access would likely affect the costs and time associated with conducting subsistence activities and could have sociocultural impacts on residents in the project area. Decreased abundance or availability of resources may result in residents spending more time and effort in the pursuit of those resources, with greater risks to hunter safety. Some residents may reduce the time spent harvesting subsistence resources if the resources are unavailable in traditional harvesting areas and residents do not have the money to expend on traveling farther. Although not anticipated, if road security were ineffective, these impacts could be further compounded by increased unauthorized access by non-local harvesters who have greater means to access resources and who have harvesting practices that are in direct conflict with traditional Athabascan and Iñupiaq values. Impacts related to resource availability, such as decreased community subsistence harvests, would likely have greater impacts to vulnerable low income, unconnected, and low-harvest households (Kofinas et al. 2016). Decreased harvests among the study communities could also have more wide-ranging effects due to the potential impacts on sharing networks within the region in addition to networks which extend to other regions (Kofinas et al. 2016; Braem et al. 2015). Sharing is a key value across the study region that is central to subsistence and that strengthens social and kinship ties across communities and regions. Such impacts have already been felt across the region in recent decades due to declining salmon returns (Brown and Godduhn 2015), and these impacts could be compounded by the project if there are further reductions in the availability of salmon, sheefish, caribou, and other resources.

Changes in traditional land use areas over time could also affect cultural identity for the Athabascans and Iñupiat of the region, as a community's identity is inextricably linked to ancestral lands. In the case of the Iñupiat of the Koyukuk River valley, their identity continues to be strongly associated with traditional uses of areas north of the Kobuk River and into the Brooks Range, despite recent shifts in contemporary subsistence patterns resulting from changes in resource availability, land management, and access. Further changes to the availability of caribou and other resources and a shifting away from the traditional/ancestral use areas could affect residents' senses of identity. The proposed road corridor bisects an area that has been a political boundary between the Iñupiat and Athabascans for thousands of years; impacts to resource availability and changes in subsistence use patterns could affect these traditional boundaries and associated cultural identity of area residents (Watson 2018). If the road reduces the availability of key subsistence resources such as caribou, moose, or sheefish, communities may also experience negative social effects (e.g., increased drug and alcohol use, increased depression) resulting from poor harvests of those resources in a given year, increased food insecurity, and perceived degradation of culturally or spiritually important places and resources.

Economic opportunity associated with increased revenue/dividends, job opportunities, and income, can have positive effects on rural communities and on subsistence use patterns by encouraging residents to

remain in their home communities and invest their income into subsistence technologies and pursuits. Increased income and job opportunities can also have negative impacts on subsistence use patterns by changing the socioeconomic status of certain community members, reducing the time available to engage in subsistence activities, facilitating a shift toward store-bought goods, and altering social roles within a community. Local jobs directly associated with road construction and operation will be limited in number, will be temporary, and will require skills and qualifications which most local residents do not have (see Section 3.4.5, Socioeconomics and Communities). Job opportunities would be greatly reduced after construction, with the road employing between 9 and 15 local residents, depending on the alternative.

All alternatives would cross ANCSA Native corporation land (see Appendix F, Table 5), some of it Doyon Limited land and some NANA land (regional corporations) and some of it land associated with smaller Native corporations. It is likely the corporations would sell gravel from their lands for road construction and maintenance, and may collectively receive tens of millions of dollars (Cardno 2015). Shareholders likely would receive dividends from the regional corporations bolstered by those payments. These funds may help individuals adapt to subsistence impacts by providing funds toward subsistence equipment and supplies, but the funds would not go solely to shareholders in communities experiencing project impacts to subsistence; the funds would go all shareholders.

Over time, decreased abundance and availability of resources, in combination with decreased access to or avoidance of traditional harvesting areas and changes in social roles and socioeconomic status, may reduce overall participation rates in subsistence or harvest amounts. When subsistence users' opportunities to engage in subsistence activities are limited, then their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge these areas as part of their traditional land use area, the loss of direct use of the land could lead to reduced knowledge among the younger generation of place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of the community. Any changes to residents' ability to participate in subsistence activities, to harvest subsistence resources in traditional places at the appropriate times, and to consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

Alternative A Impacts

Alternative A crosses subsistence use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman. Therefore, these communities would likely experience direct impacts of Alternative A on their subsistence uses in terms of direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes, habitat use, or habitat quality could extend to other subsistence study communities or, the 42 WAH WG study communities, and the 32 fish study communities.

Communities with the highest number of resource uses crossed (5 or more resources) include Bettles, Evansville, Shungnak, Ambler, Coldfoot, Kobuk, and Wiseman. Alternative A bisects community uses (i.e., community residents would need to cross or detour around the road to access a large portion of their subsistence use area) for Bettles, Evansville, Kobuk, and Shungnak; therefore, these communities would be most heavily impacted by Alternative A in terms of access. Bettles, Evansville, and Kobuk would be closest to the road corridor; therefore, they would be more likely to experience benefits of the road regarding lowered costs of subsistence supplies/equipment and other goods if the communities can develop a way to create an access route from their community to the nearby corridor (note: Kobuk is the only community that would have direct access). Appendix H describes communities' anticipated access of the route for commercial deliveries.

Key subsistence harvesting areas that Alternative A would cross include the Ambler River, Kobuk River, Mauneluk River, Beaver Creek, Reed River, Alatna River, Upper Koyukuk River, Iniakuk River and Lake area, John River, Wild River, and South and North Fork Koyukuk rivers. Each of these locations are traditional harvesting areas for multiple communities, particularly among the Kobuk River Region and Koyukuk River Region communities and for multiple resources (see Appendix L, Sections 5.1 and 5.3).

Resources for which availability or access could be directly affected under Alternative A include caribou (9 communities), moose (9 communities), small land mammals (8 communities), migratory birds (6 communities), Dall sheep (6 communities), and vegetation (6 communities) (see Appendix F, Table 28, and Appendix L). Of these resources, moose, caribou, and vegetation are resources of high importance to a majority of the potentially affected study communities. For a smaller number of communities, harvests of salmon, non-salmon fish, bear, and eggs could be directly affected. For a discussion of the nature of potential impacts to individual resources, see above under Impacts Common to All Action Alternatives, Resource Abundance and Resource Availability.

Alternative A crosses through key migratory range for the WAH and could therefore affect the availability of WAH to the south (in fall) and north (in spring/summer) of the road. The road runs perpendicular to the primary direction of movement during migration, increasing the likelihood of caribou being diverted and delayed during migration. Caribou would cross the Alternative A corridor during fall and winter (see Section 3.3.4, Mammals). Alternative A is to the north of a majority of the study communities whose caribou hunting activities peak in fall (see Appendix L). Deflections of caribou to the north of these communities during fall could substantially impact resource availability to subsistence harvesters. The likelihood of deflections of caribou to the north of these communities during fall could substantially impact resource availability to subsistence harvesters. The likelihood of large deflections would vary annually based on environmental and development-related (e.g., traffic and noise levels) factors. The importance of maintaining the north-south migration is evident in traditional hunting methods that place hunting camps to the south of rivers and allow the first of the caribou herd to pass by before hunting them (WAH WG 2017). Direct impacts to caribou availability along the road corridor resulting from smaller-scale disruptions may occur for the communities of Bettles, Evansville, Shungnak, Ambler, Kobuk, Alatna, Allakaket, Anaktuvuk Pass, and Selawik. For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Larger-scale disruptions may extend to other harvesters of the WAH. Alternative A does not occur within the range of the RMH. Traffic increases on the Dalton Highway may affect the HHH and subsistence activities near the Dalton Highway.

Under Alternative A, fish availability could be directly affected for 4 study communities: Bettles, Evansville, Shungnak (for salmon), and Ambler. Non-salmon fish are a resource of high importance to these communities, and salmon are a resource of moderate (Bettles) to high importance (Ambler, Evansville, Shungnak) (see Appendix L). In particular, sheefish spawning grounds, which are particularly sensitive to changes in environmental conditions, occur along the Alatna and Kobuk rivers, which are

crossed by the Alternative A corridor. Any impacts from construction or operation of the road corridor that change water quality downstream could affect sheefish spawning grounds, which could impact communities downstream from the corridor on the Koyukuk and Kobuk river drainages (Alatna, Allakaket, Hughes, Huslia, Ambler, Kobuk, Shungnak, Kiana, Noorvik). For most of these communities downstream from the Alternative A corridor, non-salmon fish are a resource of high importance (see Appendix L), and in the Kobuk-Selawik river basin, sheefish are a resource of high importance to the communities of Ambler, Kiana, Kobuk, and Noorvik. If impacts extend outside the Kobuk-Selawik river basin, then other communities with a high reliance on sheefish (Grayling and Nunam Iqua) could also be affected. These communities could experience indirect impacts if larger changes to fish health or availability occur. Alternative A has a greater potential to directly affect sheefish spawning grounds compared to Alternative C. In addition to sheefish spawning grounds, Alternative A also crosses streams in the Upper Koyukuk drainage (Alatna River, Henshaw Creek, North Fork Koyukuk River, Wild River, John River), which support spawning for Chinook, chum salmon, and whitefish. Chum salmon are a resource of high importance to most communities in the Koyukuk River basin (see Appendix F, Table 31). Impacts to these spawning grounds could also have larger impacts to communities that harvest salmon downstream from the road corridor.

Alternative B Impacts

Alternative B is similar to Alternative A regarding the communities that could be directly affected and the nature of the potential impacts. Alternative B crosses use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Bettles, Coldfoot, Evansville, Hughes, Kobuk, Selawik, Shungnak, and Wiseman (see Appendix F, Table 28, and Appendix L). Therefore, these communities would likely experience direct impacts from Alternative B on their subsistence uses regarding direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Alternative B would cross through similar key subsistence harvesting areas as Alternative A, with the addition of the Hogatza River area and Norutak Lake, which are used by multiple Kobuk and Koyukuk River Region communities (see Appendix L, Sections 5.1 and 5.3). The primary difference between Alternatives A and B regarding direct community impacts is that the route would not overlap with migratory bird hunting areas for Ambler but would overlap with vegetation harvest areas for that community.

Alternative B would cross within approximately 7 miles of sheefish spawning habitat on the Reed River, introducing higher potential for degradation and contamination of that habitat from spills (see Section 3.3.2, Fish and Aquatics), particularly affecting communities for which this resource is of high importance (Ambler, Kiana, Kobuk, and Noorvik). If impacts extend outside the Kobuk-Selawik river basin, then other communities with a high reliance on sheefish (Grayling and Nunam Iqua) could also be affected. In addition, impacts related to water withdrawals would be somewhat higher under Alternative B due to ice roads (and water withdrawals) occurring closer to key sheefish spawning habitat.

For caribou, the effects would the same as under Alternative A (see Section 3.3.4, Mammals). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAH WG study communities. However, the overall migratory routes of the WAH are expected to remain intact. For a discussion of the nature of potential impacts to individual resources, see Section 3.4.7.1.6.2, Impacts Common to All Action Alternatives, Resource Abundance and Resource Availability.

Alternative C Impacts

Alternative C crosses use areas for 12 subsistence study communities: Alatna, Allakaket, Ambler, Anaktuvuk Pass, Hughes, Huslia, Kiana, Kobuk, Selawik, Shungnak, Stevens Village, and Tanana. These communities would likely experience direct impacts from Alternative C on their subsistence uses regarding direct reduction of subsistence use areas, impacts on user access, and direct impacts to resource availability (i.e., localized disruptions to resource behavior or distribution resulting from project activities and infrastructure). Impacts to resource abundance or larger impacts to resource availability resulting from changes to migration routes or habitat use could extend to other subsistence study communities or, in the case of caribou, to the 42 WAH WG study communities. However, large migratory changes are less likely under Alternative C than Alternatives A and B because Alternative C does not intersect as much of the WAH's migratory range.

Communities with the highest number of resource uses crossed (5 or more resources) include Allakaket, Hughes, Kobuk, Shungnak, Ambler, Stevens Village, and Alatna. Alternative C bisects community uses (i.e., community residents would need to cross or detour around the road in order to access a large portion of their subsistence use area) for Hughes, Kobuk, and Shungnak; therefore, in terms of access these communities would be most heavily impacted by Alternative C. These communities would also be most likely to experience benefits of the road related to lowered costs of subsistence supplies/equipment and other goods if these communities can develop a way to create an access route from their community to the nearby corridor. The community of Kobuk would be located directly along the Alternative C route and Hughes is within 4 miles of the route. Appendix H describes communities' anticipated access of the route for commercial deliveries.

Key subsistence harvesting areas Alternative C would cross include the Lower Kobuk River, Pah River Flats, Hogatza River, Hughes Creek, Indian River, Melotzina River, Ray Mountains, and Ray River. Each of these locations is a traditional harvesting area for multiple communities, particularly among the Koyukuk, Tanana, and Yukon River Region communities (see Appendix L, Sections 5.3, 5.4, and 5.5).

Resources for which availability or access could be directly affected under Alternative C include small land mammals (11 communities), caribou (10 communities), non-salmon fish (8 communities), moose (8 communities), bear (7 communities), vegetation (6 communities), migratory birds (6 communities), and salmon (5 communities) (see Appendix F, Table 28, and Appendix L). For a smaller portion of communities, harvests of Dall sheep and upland game birds could be affected. For a majority of the study communities, caribou, moose, non-salmon fish, salmon, and vegetation are resources of high importance (see Appendix L). Alternative C would have greater noise impacts compared to Alternatives A and B as it would affect more previously undisturbed land than Alternatives A and B, and noise would spread wider under Alternative C due to terrain differences. Therefore, impacts on resource availability and user avoidance related to noise may occur over a greater area under Alternative C (see Section 0, Acoustical Environment (Noise). For a discussion of the nature of potential impacts to individual resources, see above under Impacts Common to All Action Alternatives, Resource Abundance and Resource Availability.

Alternative C does not cross through the primary migratory range for the WAH and does not intersect the primary north-south movement of the herd. Therefore, the alternative would be less likely to affect WAH migration routes and behavior and less likely to have direct and indirect effects on resource availability for the caribou study communities. However, Alternative C does occur within the wintering grounds for the WAH and affects an overall greater amount of WAH habitat (as opposed to overall range); therefore, direct impacts to caribou availability along the road corridor may occur for the communities of Allakaket, Hughes, Kobuk, Shungnak, Ambler, Alatna, Huslia, Anaktuvuk Pass, Selawik, and Tanana, all of which have caribou hunting areas overlapped by the alternative. Loss of winter habitat would be particularly

detrimental to the WAH due to the difficulty in accessing lichen. Reduced survival during winter resulting from a lack of foraging opportunities could have larger effects outside the immediate area and affect more distant WAH communities. As noted above, some past population declines in the WAH have been attributed to extreme winter weather conditions, lack of access to lichen, and high winter mortality rates (see Section 3.3.4, Mammals). For Anaktuvuk Pass, the road corridor is on the periphery of their caribou hunting areas. Unlike the other alternatives, Alternative C bisects the overall and summer ranges of the RMH. Due to the small population size and herd range, impacts to the RMH could be amplified; however, the RMH is difficult to access and hunted by the subsistence study communities only occasionally so direct impacts to local hunters would be possible but unlikely. Alternative C would not affect the HHH.

Compared to Alternatives A and B, Alternative C crosses areas of higher value moose habitat and therefore could have greater impacts to moose availability in nearby communities. Impacts would be relatively localized along the road system, and therefore would affect communities who have the highest reliance on moose and moose hunting areas closest to the road corridor (e.g., Hughes, Huslia, Alatna, Allakaket).

Alternative C could directly affect fish availability for a greater number of communities than Alternatives A and B (8 communities versus 4). Alternative C crosses the Kobuk River directly downstream from sheefish spawning habitat. Therefore, any changes to waterways that obstruct access to spawning grounds or affect water quality could have larger indirect impacts to communities who harvest sheefish upstream and downstream from the road corridor (Alatna, Allakaket, Bettles, Evansville, Hughes, Kobuk, Shungnak, Ambler, Huslia, Kiana). However, Alternative C would be less likely to have direct impacts on sheefish spawning grounds. In addition, while Alternative C would cross more fish streams than Alternatives A and B, it would construct more bridges and fewer minor culverts, which are more likely to obstruct fish passage.

Alternative C would also have more impacts related to ice roads and water withdrawals due to more miles of ice roads under this alternative. Alternative C would more frequently be routed along floodplains and near streams, which may put waters at higher risk for spills and sedimentation (see Section 3.3.2, Fish and Aquatics). In addition to sheefish spawning grounds, Alternative C also crosses streams that support spawning for Chinook and chum salmon. Impacts to salmon spawning grounds could also have larger impacts to communities that harvest salmon downstream from the road corridor along the Yukon and Koyukuk rivers. For many Yukon River communities, Chinook salmon is a resource of high importance (see Appendix F, Table 31) and is also a resource of yield concern to the ADF&G. Chum salmon is a resource of high importance in most communities in the Kobuk-Selawik, Koyukuk, and Yukon river basins.

Finally, because of the longer overall length of Alternative C, this Alternative would likely result in a greater number of job opportunities for local residents compared to Alternatives A and B, although relative job opportunities for local versus non-local residents would remain relatively limited.

Combined Phasing Option

Under the combined phasing option, the road would be constructed over 2 rather than 3 phases. This alternative would not involve construction of a pioneer road; instead, the construction road would be constructed to Phase 2 standards. Reducing the overall length of construction, from 3 to 4 years to 2 to 3 years would reduce the duration of construction-related noise and activity, thus reducing long-term impacts to subsistence users and resources. Initial construction of a wider road would require longer culverts and more water withdrawals for ice roads and ice pads, thus having greater potential short-term impacts to fish related to water quantity and quality. While impacts would continue during operation,

human activity and noise from air traffic would likely be less. Both air traffic and human activity can cause disturbances to wildlife, resulting in skittish behavior and changes in resource distribution and movement. Constructing the road to Phase 2 standards may lessen, but not eliminate, subsistence user concerns related to fish and water impacts.

Mining, Access, and Other Indirect and Cumulative Impacts

The cumulative impacts to subsistence resulting from the proposed road, other reasonably foreseeable developments, and climate change could result in reduced harvesting opportunities for local residents and alterations in subsistence harvesting patterns. See also Appendices L, Subsistence Technical Report, and M, ANILCA Section 810 Preliminary Evaluation, for a discussion of indirect and cumulative impacts to subsistence.

Throughout history, subsistence users have adapted to various economic, social, and environmental changes that have affected subsistence use patterns of the study communities. Major historic events which have affected subsistence in the region include pre-contact trade and contact between Iñupiat and Athabascans; initial European contact which introduced western trade goods; the fur trade in the early nineteenth century, which introduced a market economy and the use of firearms; the late nineteenth- and early twentieth-century gold rush, which resulted in territorial shifts, establishment of new communities, intermarriage, and a subsequent starvation period compounded by a caribou decline; introduction of new technologies such as outboard motors; and missionaries and school requirements, which resulted in the centralization of communities and abandonment of semi-nomadic subsistence patterns (Watson 2018).

More recent past and present actions which have affected subsistence uses and resources within the study region include mineral exploration (e.g., South32 mining exploration between the Dalton Highway and GAAR), mining development (including the Red Dog Mine), infrastructure projects, scientific research, recreation and tourism, sport hunting and fishing, hunting and harvesting regulations, establishment of wildlife refuges and national parks, and environmental changes resulting from climate change. Construction of TAPS and the Dalton Highway have affected subsistence access and resource availability for communities in the eastern portion of the project area, with many residents believing that the highway and pipeline have resulted in changes to caribou migration across the region (Alatna Tribal Council 2022; Allakaket Tribal Council 2022). The Red Dog Mine, including the DMTS and port site, has introduced contamination concerns for local residents, particularly Kivalina residents who are situated downstream from the mine, and have affected resource distribution and migration for resources such as caribou and marine mammals possibly resulting in decreased harvests of these resources over time (EPA 2009). Study communities in the region have expressed more general concerns about the impacts of mining, including recent South32 mining exploration (Evansville Tribal Council 2022), on the health of subsistence resources. In a G2G meeting, an Allakaket Tribal Council member expressed concerns about downstream effects on fish, and described seeing the effects of mining activities decades ago:

> I am totally opposed to the Ambler Road. It's cutting us off from our animals, and our water quality, and fishes. And the fish don't come down this far and stop, their waters go all the way down to Koyukuk Village and then it hits the Yukon River. All of them will be impacted, too.... In 1970 we used to go to camp and fish. One year in July we had to go across the river to check on fish nets, we just go the middle of the river, and the water was just swirling with yellow mud. We found out later that they were already mining up the Alatna. Maybe after that is when we start seeing fish that had spots on them. (Allakaket Tribal Council 2022)

Increased sport hunting and fishing in the region and associated air traffic have resulted in increased competition for local subsistence users in addition to disturbance and displacement of subsistence resources such as caribou. The establishment of GAAR in the 1980s also affected access to and use of

traditional harvesting areas for residents of nearby communities within the northeastern portion of the project area (Watson 2018).

Impacts of climate change include changes in the predictability of weather conditions such as the timing of freeze-up and breakup, snowfall levels, storm and wind conditions, and ice conditions (e.g., ice thickness on rivers and lakes), all of which affect individuals' abilities to travel to subsistence use areas when resources are present in those areas. In addition, subsistence users may experience greater risks to safety when travel conditions are not ideal. Changes in resource abundance or distribution resulting from climate change could also affect the availability of those resources to subsistence users or may cause subsistence users to travel farther and spend more time and effort on subsistence activities.

Current subsistence use patterns, as described in this section and Appendix L, are the result of the adaptation of communities to all of the above forces of change. Any future actions, regardless of how minor they seem at the time, would also contribute to changes in subsistence patterns.

RFAs within the region that could contribute to subsistence impacts include development of the District (Arctic, Bornite, Sun, and Smucker projects); other mining activities (e.g., Manh Cho Mine); use of the Ambler Road for commercial access; use of the Ambler Road for commercial use by local communities and Native Allotment owners; secondary access roads connecting the Ambler Road to other mining areas and claims, Air Force lands, and local communities; infrastructure projects (e.g., OTZ Telephone Cooperative communication towers), as well as changes in land management;. Dalton Highway improvements are expected to be minor changes to an existing road and likely would not have substantial new effects on subsistence. The cumulative impacts to subsistence resulting from the proposed road and these RFAs could result in reduced harvesting opportunities for local residents and alterations in subsistence harvesting patterns (see Appendices H, L, and M). The project would introduce a large industrial road corridor into an area that was previously undeveloped and used primarily for subsistence and recreational purposes. Under any alternative, 12 communities have subsistence resource use areas impacted by the project corridor(s), and a majority of these communities are rural, low-income, non-road-connected communities that rely on subsistence to support their mixed economy.

The potential for increased access into the project area resulting from unauthorized use of the project road and ROW may increase competition in the region for certain resources and decrease harvesting success for local hunters. Illegal trespass by unauthorized users along the Ambler Road will likely occur by both local/regional residents and non-local individuals, particularly during the hunting season. While these instances may be sporadic, they may also increase disturbances to resources and competition for local hunters, particularly in areas where existing trails and roads intersect with the road alignment. Unauthorized public use of the road may result in use of the road corridor by non-local hunters, increasing competition with local communities and potentially affecting resource availability. Increased access to the area resulting solely from unauthorized use of restricted roads and/or ROWs would likely not have the same level of impacts on harvesting success as authorized uses. While large mines would likely have policies regarding hunting and fishing by workers, smaller mining outfits or individuals may allow these activities if the road were open to individual and recreation mining claims, thus increasing the potential for hunting competition. The potential for increased access to the region resulting from a publicly accessible road is a primary concern that has been voiced by residents during both scoping and traditional knowledge studies associated with the Ambler Road (Allakaket Tribal Council 2022; BLM 2018a; Watson 2014). Many residents do not believe that the road will remain private and point to previous private access roads that eventually opened to the public (e.g., the Dalton Highway). While the BLM is not considering issuance of a ROW for a public road, it is reasonably foreseeable that there may be some public uses of the road, including local resident use of the Ambler Road for subsistence purposes; commercial use of the road by local communities; uses by individuals with existing land use rights; and,

after the useful life of the road for mineral development, efforts to convert the road to a public road (see Appendix H, Sections 2.2.2, Public and Non-Industrial Access, and 2.2.3, Trespass Scenario, for details on potential changes in road access and use).

AIDEA has proposed allowing some commercial access to communities, which could result in increased access to and decreased costs of goods, such as food and equipment. Under any alternative, the road may increase access to and reduce costs of commercial goods for certain communities; however, few local jobs directly associated with the road (e.g., maintenance and operation) will be available after construction, and relatively lucrative mining jobs are more likely to go to NANA shareholders and to residents of the closest communities (Kobuk, Ambler, and Shungnak) because 2 of the largest mines are on NANA land or subject to NANA agreements. Such jobs, which allow for both relatively high income and chunks of time off that may be used for subsistence activities, are less likely to go to Doyon shareholders whose subsistence areas would be equally affected. Those communities in the Doyon region, with fewer job benefits coupled with distance from the new road, would be further affected because they would not benefit from reduced costs of supplies and fuel; only communities close to the road, such as Bettles/Evansville (Alternatives A and B) and Hughes (Alternative C) have the potential to see benefits from reduced costs of fuel, goods, and groceries, including fuel, fishing and hunting tools, snowmobiles and boats that help in the subsistence harvest. Other subsistence communities in the Doyon region would experience the impacts of the road crossing their subsistence use areas but would be too far from the road to benefit from the reduced costs of subsistence activities. In addition, NANA region communities would benefit by dividends bolstered by payments from the mines. While the project may not reduce subsistence harvests to levels seen along other road-connected communities in the state, the combination of reduced resource availability, decreased user access, increased income (for some communities), and increased access to commercial goods (for some communities) would likely alter subsistence harvesting patterns across the region and affect overall subsistence harvests for certain communities.

Secondary access roads developed by communities would likely be used, at least by local residents, for subsistence harvesting activities and could create harvesting corridors and increase competition within those areas. If the Ambler Road also becomes open to local use for subsistence purposes, then such a road could have positive and negative impacts on subsistence. Some residents would likely use the road to access subsistence hunting and harvesting areas. The use of industrial roads for subsistence purposes has been documented on the North Slope of Alaska. Roads provide easy access to hunting areas, particularly for individuals who do not have access to snowmachines and ATVs; who have limited time to engage in subsistence activities; or who have health or other issues that make overland travel difficult. Access to the road may also help to mitigate some of the effects of the road on resource migration and distribution, as residents may be able to travel farther to access areas with heavier concentrations of the resource.

While commercial and subsistence access to the Ambler Road would have impacts to subsistence, they may also provide benefits to local communities and subsistence users. Comparatively, public access to the road for outsiders would likely have substantial negative impacts to subsistence users by increasing competition for subsistence resources, increasing disturbances to wildlife, and decreasing harvest success for local residents. According to Guettabi et al. (2016), increased access resulting from the road and/or ROW would likely reduce harvest success for local hunters, particularly for moose (see Appendix L for a more detailed discussion). According to the WAH WG (2017), communities within the region have already experienced increased competition in traditional hunting areas, with greater numbers of hunters concentrated within smaller areas. Sport hunting is a key issue within the region for subsistence harvesters, and public access to the area via a road or ROW would contribute to these impacts.

Increased hunting activity along a road corridor into a previously road-free region could result in changes to resource distribution and behavior along the road corridor, particularly if hunting activity deflects

migrating resources such as caribou. In addition, an increase in outsiders in the region may have cultural and spiritual effects on local residents if they witness hunting behavior that is inconsistent with traditional Athabascan and Iñupiaq values (e.g., not targeting the "lead caribou" in a herd, wasting meat) (see Appendix L). Overall, increased non-local access into the region, which may occur in any area where ROWs intersect with public road corridors, would increase subsistence competition and reduce resource availability and harvest success for local residents.

Those communities close to the road that end up connecting by spur road or trail, or just by snowmobile or boat, could experience a change in the balance between the subsistence economy and cash economy. A recent study comparing road-connected to non-road-connected communities showed that road-connected communities have substantially lower subsistence harvests than non-road-connected communities (Guettabi et al. 2016). The correlation between public roads and subsistence harvests has been documented in other studies, with Magdanz et al. (2016) finding that a community's location on a public road was expected to reduce subsistence harvests by approximately one-third but was not consistently correlated with an increase or decrease in income.

If the road does not become public and once the road is reclaimed, portions of the remaining cleared ROW would likely become a route for local and non-local hunters traveling by OHVs, at least in areas between major bridges. If the reclaimed road alignment increases access into the region, state and federal regulators may respond by introducing stricter hunting and harvesting regulations, which would affect availability of resources to local communities. To the extent there is increased competition and decreased resource availability, the existence of the corridor may result in residents having to travel farther and spend more time, money, and effort to harvest resources such as moose and caribou.

The Ambler Road would facilitate additional mining and other development throughout the study region, which would contribute to impacts on subsistence resource abundance, resource availability, and user access for subsistence users across the region. Mining development would result in the physical removal of traditional subsistence hunting and harvesting areas for the study communities in addition to decreased access to these areas through security/access restrictions and through user avoidance of development areas. The overall area available for subsistence use would likely shrink over time due to the increasing presence of infrastructure and human activity within traditional use areas.

The hypothetical development scenario assumes that the road would result in aggressive exploration of the Ambler Mining District and that the 4 most advanced mining projects would be developed. With production activities at each development expected to occur over 5 to 35 years, the overall life of mining development associated with the road would likely extend well beyond 35 years. While the proposed road would be the primary access to the District, access roads would likely occur to individual developments, contributing to habitat fragmentation in the region. Construction and mining activities associated with development of these projects would result in a long-term increase in impacts associated with human activity, noise, traffic, infrastructure, visual disturbances, smells, and contamination, which could affect the abundance and availability of resources such as caribou, moose, fish, waterfowl, and vegetation. Direct impacts would be highest for the communities closest to these 4 development projects—Kobuk, Shungnak, and Ambler—although indirect impacts would also occur for communities that harvest fish downstream from the projects and communities who harvest WAH caribou.

The Ambler Road would introduce impacts to resource abundance and resource availability for key resources such as sheefish, whitefish, salmon, and caribou, while also reducing (rather than facilitating) access to traditional harvesting areas. Mining activities would cause further disturbance to wildlife through the presence of mine pits and noise and disturbance from heavy machinery, blasting, and human activity. Mine development and additional road construction would also contribute to further contamination and alteration of waterways, which may cause substantial impacts to spawning grounds

and other habitat for non-salmon fish (sheefish and other whitefish) and salmon that are key subsistence species across the region. One of the proposed mines (Sun) and Alternatives A and B would be located upstream of sheefish spawning habitat and could damage that habitat and impact subsistence resources for downstream communities. Mining and further road development could have population-levels effects on certain fish species, particularly if mine activities result in contamination or impact to Kobuk River sheefish spawning grounds (see Section 3.3.2, Fish and Aquatics). Fish and other wildlife may be adversely impacted by toxins, such as PAHs, that enter the environment as a result of road construction and mining activity. These compounds are toxic to fish, amphibians, aquatic invertebrates, and other wildlife and are known to bioaccumulate through trophic levels (Fisher 1995). Consumption of fish and wildlife contaminated with PAHs may constitute human health risks if populations are exposed to hazardous levels, which can include duration of exposure, concentration of PAHs, and amount and type of food consumed (European Commission 2002; Wickliffe et al. 2014). Many communities across the region, including in the Kobuk-Seward, Koyukuk, and Yukon river basins, have a moderate to high reliance on sheefish (see Appendix F, Table 31). Impacts of a decline in sheefish could have effects on all of these communities, and many have larger impacts if the decline in sheefish results in a higher harvest of other resources.

Further development of the District and associated roads would contribute to additional habitat fragmentation for resources such as caribou and moose; impacts on caribou migratory patterns would increase with the density of infrastructure development. Similar to fish, impacts to caribou migration and abundance could reverberate throughout the communities who rely on the WAH. These impacts would be particularly likely among communities for whom caribou is a resource of high importance (see Appendix F, Table 30), but could extend beyond those communities if a decline in caribou harvests affects sharing networks or results in higher harvests of other resources (e.g., moose).

Other RFAs which could contribute to changes in subsistence resource availability include changes to land management. The BLM is currently preparing an EIS regarding potential revocation of ANCSA 17(d)(1) withdrawals, including parcels in the Kobuk-Seward planning area. Revocation of withdrawals on certain parcels of land could result in changes in subsistence management, including the loss of federal subsistence priority on those lands for local residents. Such changes, in combination with increased hunting competition in the region, could affect subsistence uses and harvest success for certain study communities.

Decreased harvests among the study communities could have wide-ranging effects due to the potential impacts on sharing networks within the region in addition to networks that extend to other regions (Kofinas et al. 2016). Sharing is central to subsistence and is a key value across the study region. Decreased harvests could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed. A study in the Upper Kobuk Region documented sharing networks which extended to the major urban centers of Alaska, the North Slope, Northwest, Southeast, Southwest, and Interior Alaska, during a single study year (BLM 2023; Braem et al. 2015;). Because of the large number of communities who harvest from the WAH and the extensive sharing networks maintained by these communities, a decline in herd size or a substantial change in the migration or distribution of the herd could have wide-reaching impacts on sharing networks which extend well outside of the study region to other regions of Alaska.

Communities in the study region currently have high levels of unemployment and low income with high costs of living; despite these factors, many of the study communities have remained stable and resilient through a mixed economy that revolves around subsistence hunting and harvesting (Guettabi et al. 2016). Construction of the proposed road and associated mining development would result in increased employment opportunities and income for residents of some of the subsistence study communities.

Residents may invest the income from construction, operation, and mining jobs into supplies and equipment (e.g., snowmachines, outboards, fuel, ammunition) to support subsistence activities. In addition, the ability to use the road to transport commercial goods, including subsistence supplies and equipment, may also reduce certain costs associated with subsistence. However, at this time, there is no guarantee that this benefit is certain for any community. In addition, benefits associated with increased employment and income would be most likely to occur for NANA shareholders and communities due to agreements between mining companies on NANA lands regarding local hire policies. Thus, interior communities such as Alatna, Allakaket, Bettles, and Evansville may experience subsistence impacts (e.g., reduced resource availability and access to traditional harvesting areas) without the counter benefits of increased income and employment associated with mine development.

Those individuals who obtain long-term employment associated with the road or associated mining developments may experience reduced time to engage in subsistence activities, although they may continue to invest monetarily in and support subsistence activities for others in the community. Those with mining jobs may move away from their communities, as some have done in association with the Red Dog Mine, to larger urban centers. The benefits of increased employment and income would likely only occur for certain households and certain communities and could cause social tensions associated with increased inequality. As noted in BurnSilver and Magdanz (2019), household responses to social, economic, and environmental change are not homogenous, and benefits of economic growth are generally not distributed equally. Certain households are more vulnerable to changes in community economic status and disruptions in subsistence harvesting, social ties, and sharing. Household sensitivity and adaptive capacity are good indicators of how households would respond to sudden change. Factors determining household sensitivity include low-harvest, low-income households, or households, which are "unbalanced" or "spread thin" (e.g., medium-harvest, low income; or low harvest, high income). Certain communities have greater adaptive capacity, overall, than others, but all communities show significant variation among individual households. Thus, increased economic benefits to a region would not be distributed equally to all households and the most vulnerable households would likely experience the greatest consequences of subsistence disruptions through weakened social networks and the inability to adapt to changes in resource availability.

Similarly, impacts to resource availability and user access would be most pronounced for communities that do not experience increased income associated with the road (i.e., road or mining jobs) and/or do not experience benefits of the road related to lowered costs of subsistence supplies/equipment, food, or other goods. These communities would have less opportunity to purchase or invest in fuel and equipment to adjust to changes in access and resource availability. The comparative lack of economic benefits for certain communities, such as those farther removed from the road alignments, could make those communities more vulnerable to social and subsistence impacts, particularly those associated with disruption of subsistence activities. Without the economic benefits of development, communities are more vulnerable to the impacts of the same development and less able to adapt to environmental and social changes resulting from the development.

In rural Alaska, certain households or individuals play a particularly important role in harvesting and distributing subsistence foods to households and individuals who are unable to hunt or harvest for themselves. Research from the ADF&G has found that as a general rule, 30 percent of households, referred to as "super-harvester households," generally harvest 70 percent of the total community harvest (Wolfe 20004). Harvests may be even more concentrated for specific resources such as caribou (SRB&A 2016; Kofinas et al. 2016). An increase in employment associated with the road and mine developments may result in some households or individuals shifting away from their roles as super-harvesters as they have less time to engage in subsistence activities as they once did.

Subsistence roles within a community regularly change and evolve due to household circumstances (e.g., age and number of household members, employment levels, income, health), and communities generally adapt to these changes, with new harvesters filling or returning to previous subsistence roles as their circumstances allow and as the need presents itself. In addition, the roles of super-harvester households and high-earning households are not mutually exclusive. Kofinas et al. (2016) found that many super-harvester households are high income households, and the vast majority of high harvesting households have at least 1 employed household member. Other research has shown an inverse relationship between income and harvesting levels, with high income associated with lower harvests (Guettabi et al. 2016). On a community scale, Magdanz et al. (2016) found a 2.5 percent decrease in in household mean harvests for each 10 percent increase in household income. In a single study community controlling for household size, the harvest-income association disappeared. Thus, recent research suggests that at a community and household level, increased income is not associated with increased harvest.

It is likely that responses to increased income would vary by households; some households would invest their increased income into subsistence pursuits (including providing gas and supplies to active harvesters from other households), while others may gradually participate less in the subsistence economy. A sudden increase in employment levels in a community may cause at least a temporary disruption in social ties and roles within the subsistence study communities, which could cause a decline in the distribution of subsistence foods for a period of time.

A number of studies have documented the resilience of subsistence communities in the face of sudden or dramatic changes, noting that communities and households often respond to scarcity of 1 resource (caribou) by increasing their harvests of another, or by increasing income sources when subsistence foods are less available (Martin 2015). Resilience allows communities and households to adjust to changes while maintaining access to key cultural resources and activities. However, the ability of households to be resilient in the face of change does not negate the existence of impacts, nor does it imply that households can simply adapt to all forces of change. In addition, as discussed above, communities and households are not homogenous in their capacity to adapt to sudden change (BurnSilver and Magdanz 2019). Larger disruptions to subsistence ties, particularly in combination with decreased availability of key subsistence resources, could affect social, cultural, and economic well-being, particularly to the more vulnerable low income, unconnected, and low-harvest households who rely on strong sharing networks for their food security (Kofinas et al. 2016). Over time, if communities in the region become road-connected, experience an increase in the availability of goods, income, and employment opportunities; and also experience decreased harvesting opportunities, this could result in an overall decrease in subsistence harvests among the study communities (Magdanz et al. 2016).

Indirect and cumulative impacts of Alternatives A and B related to resource abundance and availability would likely be greater than those under Alternative C, as they would be more likely to affect resource availability of migrating caribou to the subsistence study communities, particularly during fall, and are more likely to adversely affect sheefish and whitefish, key subsistence species among the study communities. These alternatives would also be more likely to have larger indirect effects on caribou availability to the 42 caribou study communities and downstream effects on the 32 fish study communities. However, impacts related to user access and on resource availability along the road corridors would be similar across all alternatives and would affect a similar number of study communities, albeit not the same set of communities.

When subsistence users' opportunities to engage in subsistence activities are limited, their opportunities to transmit knowledge about those activities, which are learned through participation, are also limited. If residents stop using portions of the project area for subsistence purposes, either due to avoidance of development activities or reduced availability of subsistence resources, the opportunity to transmit

traditional knowledge to younger generations about those traditional use areas would be diminished. While communities would likely maintain a cultural connection to these areas and acknowledge them as part of their traditional land use area, the reduction in direct use of the land could lead to reduced knowledge among the younger generation regarding place names, stories, and traditional ecological knowledge associated with those areas. There would also be fewer opportunities for residents to participate in the distribution and consumption of subsistence resources, ultimately affecting the social cohesion of affected communities. Degradation of traditional lands can also have spiritual effects on subsistence users; the Iñupiaq and Dene view their lands as sacred and have a cultural obligation to protect them:

> The land is not just sacred to us, it is sacred to the wildlife that is living up there. We are one with wildlife and one with nature, that predates the western invasion or whatever you might call it. There is wildlife out there and we are going to be speaking for the wildlife. They need to be protected. (Allakaket Tribal Council 2022)

Any changes to residents' ability to participate in subsistence activities, harvest subsistence resources in traditional places at the appropriate times, and consume subsistence foods could have long-term or permanent effects on the spiritual, cultural, and physical well-being of the study communities by diminishing social ties that are strengthened through harvesting, processing, and distributing subsistence resources, and by weakening overall community well-being.

For a more detailed discussion of mining, access, and other indirect and cumulative impacts, see Appendix L, Section 6.6.

3.4.8 Cultural Resources*

Affected Environment

Cultural resources is a broad term and includes archaeological, historical, and architectural resources; structures; travel corridors; and places of religious, spiritual, or cultural significance to Tribes, including Traditional Cultural Places[75] (TCPs), Sacred Sites, traditional use areas, cultural landscapes, and geographic features. The study area for cultural resources extends for 5 miles on either side of each action alternative and related infrastructure components. The study area crosses a large portion of Interior Alaska, which Alaska Natives have used for thousands of years.

The data for the cultural resource analysis in the original EIS were compiled from the National Register of Historic Places (NRHP), the Alaska Heritage Resources Survey (AHRS) database (ADNR, Office of History and Archaeology 2019), the ADNR Division of Mining, Land and Water RS2477 trails database (ADNR n.d.), and recent cultural resources investigations and ethnographic studies within the study area (e.g., Blanchard et al. 2014a, 2014b, 2015; Watson 2018), the Cultural Data Gap Report that was developed for the proposed project, and an archaeological sensitivity model prepared on behalf of this project (Sweeney and Simmons 2019).

Additional and updated data sources used in the cultural resource analysis for this Supplemental EIS includes updated AHRS (ADNR, Office of History and Archaeology 2023) and RS2477 (ADNR n.d.) database queries; nominations and reports regarding ACECs (e.g., Allakaket Village 2022; BLM 2015; Huslia Tribe 2022); and new field surveys and collaborative cultural resource investigation regarding place names and ethnography within the study area (e.g., AIDEA 2021a, 2021b; Skinner 2023; Smith

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[75] The original National Register Bulletin 38 referred to traditional cultural properties. Recent guidance by the NPS in their revised National Register Bulletin 38 has adopted the term traditional cultural places

2021; Sweeney et al. 2022). The 2022 draft annual fieldwork report for the Ambler Access Project has been completed.

Ethnographic Overview

All action alternatives cross the traditional homeland of many Alaska Native groups, including Koyukon and Tanana Athabascans along the southern and eastern portions of the project area, and Iñupiat peoples along the western and northern portions of the study area. The Koyukon traditionally occupied a vast area from the middle Kobuk River, throughout the Koyukuk drainage, to the Yukon River, while the Tanana lived in the Tanana River drainage (Andrews 1977; Simeone 1985). In general, both groups followed a seasonal subsistence pattern where several families would camp at the junction of major rivers and streams during summer to fish and collect game and plant resources, and then relocate to upland lakes during fall to hunt caribou. In early winter, families would build semi-subterranean moss houses, and live in them for part of the winter. Towards the end of winter when food stores were depleted, family groups would disperse to hunt caribou, harvest small game, and sometimes travel long distances to trade with their Iñupiat partners (Brown 2007).

Historically, individual Iñupiat nations occupied the Kotzebue region (the Qikiqtaġruŋmiut nation), the Kobuk River Valley (the Akuniġmiut, Kuuvaum Kaŋiaġmiut, Kuuŋmiut nations), and the Central Brooks Range (the Tulugagmiut and Nuataaġmiut nations) (Brown 1988; Burch 1998). Iñupiat settlement and subsistence patterns varied somewhat from Athabascan groups. Generally, winter was spent in a sod house in a village of several families, and summers were spent moving between short-term camps in pursuit of seasonal resources. Both villages and short-term camps were located in areas with reliable subsistence resources and fresh water. Villages often had a community men's house called a qargi and a hallmark of Iñupiat culture were pottery or soapstone oil lamps were used to provide heat and light inside houses (Burch 1998; Oswalt 1967).

Caribou was a key subsistence resource and was harvested throughout the year for both Athabascan and Iñupiat groups. Migratory waterfowl, fish, fur-bearing animals, small game, and plants were all harvested for both food and for material resources. Some Iñupiat groups also harvested marine resources (subsistence resources are also discussed in Section 3.4.7, Subsistence Uses and Resources). Variations in subsistence and settlement patterns depended on the seasonal availability and abundance of different resources and the timing of gathering for trading fairs and other events.

There are a number of traditional place-names in the study area, indicating long-term prehistoric and historic land use and complex patterns of trade and migration were present in the region for millennia. Just as they are currently, rivers were heavily used for transportation, and the Kobuk River was a major travel and trade route between the Kotzebue Sound and the Koyukuk River and the central Brooks Range region. Similarly, the Koyukuk River, which flows into the Yukon, and the Alatna and John Rivers were used as major transportation routes for goods and people into Interior Alaska.

Archaeological and Historic Overview

The archaeology of Interior and Northern Alaska spans nearly 14,000 years of human history. The term "archaeological tradition" is used to describe a recurring assemblage of material objects that are found together in archaeological contexts and date to a specific period of time, which archaeologists use to understand and interpret past human behavior and lifeways. Archaeological traditions that are present, or may be present, in the study area include the Paleoindian tradition (13,700 to 9,600 years before present [BP]); American Paleoarctic tradition (11,300 to 7,800 BP); Northern Archaic tradition (7,000 to 3,000 BP); Arctic Small Tool tradition (5,000 to 1,200 BP); Norton Tradition (2,500 to 1,800 BP), which is considered ancestral to the culture and heritage of modern Iñupiat people; and the Athabascan tradition

(1,200 BP to approximately 1880 AD), which is considered ancestral to the culture and heritage of modern Koyukon and Tanana people. Appendix F, Table 32 describe these traditions in more detail.

From approximately 1880 on, there was a heavy Euro-American presence in Interior and Northwest Alaska. Between 1850 and 1910, commercial whaling in the Kotzebue Sound and Bering Straits region had a major impact to traditional Iñupiat lifeways, and their economy became increasingly cash-based. Marine resources and caribou herd numbers significantly decreased during this time, likely due to the increased resource pressures from the commercial whaling crews. In the 1880s, the caribou crash became so dire that a famine occurred in Northwest Alaska and the Central Brooks Range, and hundreds of Iñupiat people died or permanently relocated to the coast where marine resources were more readily available (Burch 2012). Beginning the 1880s, miners began prospecting along the Kobuk and Koyukuk rivers and in response, several trading posts were established to supply the miners. The influx of non-Natives into Interior Alaska brought epidemics like measles and influenza, which depopulated whole villages along the Yukon River and its tributaries and had major and lasting impact to Alaska Native communities. Sickness was also compounded by the caribou crash during this time, and many of the individuals that survived were faced with starvation (Brown 2007). Other Euro-American presence also included traders, missionaries, and teachers, many of whom contributed to the establishment of permanent settlements and villages and helped to establish many social and economic systems that shaped the history of Alaska.

Archaeological and historic themes relevant to the study area have been further developed and researched as part of ongoing work associated with the Ambler Access Project PA (see AIDEA 2021b). These themes include traditional subsistence economy, traditional trade networks, historic exploration and travel corridors, prospecting and mining, and guiding. Each theme includes associated property types. For example, traditional subsistence economy is associated with single-use and reoccupied camps; winter village sites; kill, butcher, and cache sites; trap lines; tree blazes and trap sets; caribou corrals and fences; drive lines/inuksut (cairns); hunting lookouts; and fish traps and nets. Additional themes that apply to the study area that have been suggested by consulting parties as part of the PA process include warfare, seasonal travel routes, religion/spirituality, missionary activity, reindeer herding, wilderness preservation and the environmental movement, militarization of Alaska, and oil development in Alaska.

Previous Cultural Resources Investigations

Archaeological and ethnographic research has been conducted since the nineteenth century in Interior and Northwestern Alaska as a result of early exploration, academic research, and compliance-based work carried out by public and private entities. The results of the 2023 AHRS query search for previous surveys that intersect with the 3 alternatives by Meridian, Township, Range, and Section (MTRS) designations (the most precise method for searching for previous surveys) revealed that previous surveys outside of those associated with the proposed project are relatively sparse (see Appendix F, Table 33). The query identified 288 MTRS associated with Alternative A and 26 total cultural resource–related documents of which 18 were survey focused; the 322 MTRS associated with Alternative B returned the same documents as Alternative A. Lastly, the query identified 486 MTRS associated with Alternative C and 24 total cultural resource documents, 17 of which were survey focused. Ten of the documents from Alternative C also were returned in the Alternatives A and B queries.

Archaeological surveys for the project occurred in 2013 and 2014 by Northern Land Use Research, Alaska, on behalf of AIDEA, and included both a reconnaissance survey (Blanchard et al. 2014b) and pedestrian survey (Blanchard et al. 2015) for the route alignments at that time. Very little cultural resources fieldwork has occurred along the Alternative C corridor, with approximately 6 miles of the 2013 reconnaissance survey coinciding with the Alternative C alignment west and north of its intersection with Alternatives A and B. Following the Ambler Road Final EIS and development of the PA, AIDEA

sponsored several years of additional cultural resource fieldwork efforts focused along Alternative A, which have been summarized in various fieldwork and annual reports (e.g., AIDEA 2021). If an alternative is authorized as part of the Supplemental EIS, AIDEA would be required to continue to inventory archaeological, historic, and ethnographic resources within the Area of Potential Effects (APE) for the entire route, according to the stipulations in the Section 106 PA (see Appendix J).

GIS and Viewshed Modeling

In an effort to identify potential areas where prehistoric and protohistoric resources are likely to be in the direct and indirect APEs and increase the potential to locate these resources in a large study area, Northern Land Use Research, Alaska, prepared a prehistoric archaeological resources sensitivity model specific to the project (Sweeney and Simmons 2019). The model results divided the study area into high, medium, and low potential zones for cultural resources. Although the lack of previous cultural resources surveys in the region limits the accuracy of the model, the model suggests that 80 to 90 percent of the modelled study area is either high or medium probability for prehistoric and protohistoric archaeological resources, indicating that there is a high likelihood that archaeological resources would be located along any of the routes. As part of the ongoing PA process, AIDEA and its cultural resource subcontractors have continued to refine the GIS modeling efforts for the project focused on Alternative A, which was the alternative selected in the Final EIS ROD, with the inclusion of additional environmental (e.g., wetland, LiDAR) and cultural data sets (e.g., AHRS sites). The BLM has also developed a viewshed analysis area focused on the proposed action to assist in analyzing potential visual impacts to cultural resources.

Known Resources

A total of 400 previously recorded AHRS sites are located within the study area, as of June 2023 (ADNR, Office of History and Archaeology 2023). The majority of previously recorded sites are prehistoric, although a portion are historic. Site types include cairns, roads and trails, caribou fences, activity areas, hunting stations, cabins, traps, mining camps, historic shelters, and historic debris and artifact scatters (ADNR, Office of History and Archaeology 2023).

In addition to AHRS sites, this analysis identified 17 RS2477 trails in the study areas. RS2477 derives from Section 8 of the Mining Law of 1866 and provides for ROW for the construction of highways over public lands. Pack trails, sled dog trails, and wagon roads are all examples of RS2477 roads and trails (ADNR 2013). In general, many RS2477 trails meet the age requirements necessary to be considered historic sites and therefore consideration as historic properties under the NRHP.

There are hundreds of traditional place names across the study area. Place names are often associated with places that are culturally significant and can be considered a culturally important indicator for ethnographic resources. Place names are frequently identified on maps as points, even though the place name may represent larger natural features such as creeks, rivers, lakes, ancestral and modern village sites, resource locations, or mountain ranges that extend for some distance. Research has included the early work of Jules Jette (1910); documentation of Koyukon place names in the communities of Huslia, Hughes, and Koyukuk (McCloskey et al. 2014); documentation of place names in the communities of Alatna, Allakaket, and Hughes (YRDFA 2008); and documentation of place names in Koyukon communities (Jones 1986; Nelson, Maunter, and Bane 1982). Iñupiaq place name documentation in the region draws on the research efforts of Burch (1994), Anderson, Anderson, Bane, Nelson, and Towarak (1998), Nelson et al. (1982) and YRDFA (2008). GAAR, in association with anthropologist Eileen Devinney, developed the Iñupiaq Place Names Project in the 1990s, which compiled Iñupiaq place names from several projects in the region into a single source. The NAB has been recently involved in the *Iñuuniałiqput Iḷiḷugu Nunaŋŋuanun* (Documenting Our Way of Life Through Maps) compilation of Iñupiaq place names in the region. The Alaska Native Place Name database is one of the largest

compilations of Indigenous place names for Alaska with nearly 25,000 records (Smith and Kari 2023). Based on the Smith and Kari (2023) data set, there are 108 place name lines (e.g., rivers and creeks) and 127 place name points within the study area for Alternatives A, B, and C combined (see Map 3-33; Appendix F; Table 34). In a number of cases, the line features have corresponding point features and may be duplicates of the same named location (e.g., line and point for the Kobuk River). Smith (2021) recently completed a place name compilation on behalf of the Ambler Access Project for Alternatives A and B and identified 34 Koyukon and 157 Iñupiaq named features within the place name study area. The majority of named features nearest to the project were hydrological features such as creeks, rivers, and lakes, many of which have been used and are continued to be used by Indigenous people. As part of the Supplemental EIS review process, TCC has identified Tlaakk'oł Neekk'e (North Fork of the Koyukuk River), Eł Tseeyh No' (John River), Aalaatne (Alatna River) and its Malamute Fork, Dodzen Beetno' (Wild River), Noye'e [No'] (Beaver Creek), and Kobuk River as commonly traveled rivers. Other names were associated with hills, locales, trails, and portages. Smith's (2021) research concluded that the place names are generally associated with Dene and Iñupiaq seasonal movement patterns through the landscape, including travel corridors, locations of seasonal subsistence activities, and other places of use and occupancy. The documentation of ethnographic resources in the study area is incomplete. However, based on the long history of land use in the region, ethnographic resources likely exist within the study area and could include sites, landscapes, structures, objects, or natural resources such as plants, fish and wildlife, minerals, or water bodies that have legendary, religious, subsistence, or other significance to the community or group that shares those values. Watson's (2018) research focused on identifying contemporary and traditional land use areas (a type of ethnographic resource) for Evansville/Bettles, Allakaket, Alatna, Hughes, Huslia, Kobuk, Shungnak, and Ambler. Additional details and analyses regarding these use areas are included in Appendix L and associated maps and demonstrate the expansive and culturally important connection that Indigenous communities have to the study area. Because of the lack of research on ethnographic resources, the BLM has been conducting interviews with Indigenous communities nearest the project as part of the stipulations of the PA to identify ethnographic resources, including non-tangible sites of cultural, religious, and traditional importance. The most recent status report of these efforts identified 12 ethnographic resources, including camps, caches, a trail and portage, traditional use areas, house pits, dugouts for hiding, a Native allotment, a caribou hunting area, a Sacred Site, and other places of cultural importance (Skinner 2023). The report also identified next steps for further research. AIDEA's Tribal Liaison Program staffs local residents from the Ambler Access Project region to provide both survey support and local cultural knowledge during field surveys that adds valuable ethnographic context to the types of cultural activities that have occurred in the survey area as well as input regarding previously undocumented cultural resource sites found during the field survey.

Other potential sources of information for ethnographic resources include the BLM's management designation of ACECs. Areas of ACEC designation require special management to protect important historical, cultural, and scenic values, or fish and wildlife or other natural resources. While 2 existing ACECs (Tozitna and Indian River) are crossed by Alternative C, neither are designated because of cultural or historical values. However, several recent ACEC nominations by the Allakaket Tribe, Koyukuk Tribal Council, and Huslia Tribe have identified areas of cultural or historical value. The Jim River ACEC expansion nomination crosses Alternatives A and B. This ACEC was nominated by the Allakaket Tribe for cultural values, including traditional fishing and hunting areas that have cultural significance to the Tribe and research to support nomination of TCPs in the area confirming the importance of the overall area as one of few areas where salmon are available due to spawning habitat (Allakaket Village 2022). The Koyukuk River Tributaries nomination by the Koyukuk Tribal Council states that the river and its tributaries hold significant historical and cultural value to the Koyukon People and that the fish and wildlife species are important to subsistence use and Tribal traditions (BLM 2015). Huslia's ACEC nomination was related to protection of watersheds of the Yukon and Koyukuk rivers and

their tributaries, which the Huslia Tribe have traditionally hunted, fished, and trapped and gathered on for thousands of years (Huslia Tribal Council 2022).

Environmental Consequences

This section addresses the impacts of the construction, O&M, and reclamation of the proposed road to cultural resources. Federal agencies encourage environmental review coordination under NEPA and the National Historic Preservation Act (NHPA) (CEQ and ACHP 2013) and coordination of review under these laws is codified in the NEPA's implementing regulations at 40 CFR 1500–1508 (40 CFR 1502.25[a]). While the NHPA deals with a subset of cultural resources known as historic properties[76], NEPA takes a broader approach and addresses both cultural resources and historic properties. For a cultural resource to be determined eligible for listing on the NRHP, it must typically be a minimum of 50 years in age and meet the eligibility requirements for historic properties described in the implementing regulations of the NHPA (36 CFR 60).

For the purposes of the NHPA, historic properties are considered within an APE, which is the geographic area within which a proposed project may result in direct or indirect adverse effects to historic properties. As part of the PA process during the Final EIS, the BLM defined the APE for this project as a 1-mile buffer on each side of the project corridor and around all project components (see Appendix J, Attachment A). As part of the remand, the BLM revisited the APE definition to ensure potential adverse effects are adequately considered, particularly in regard to considering visual, auditory, and olfactory impacts. The Supplemental EIS uses the 10-mile-wide study area to broadly encompass the APE, and uses the ROW corridor (generally 500 feet wide) to address cultural resources that would be most likely to be destroyed or damaged from construction of the road and associated project components (e.g., turnouts, camps, staging areas, material sources, airstrips, access roads, maintenance stations).

Adverse effects to historic properties are being addressed through the Section 106 process by means of the PA, which applies to all project activities, regardless of land ownership, and to all phases of the project. See Appendix J for a copy of the agreement. The PA (see Appendix J) addresses the process for identifying historic properties and resolving potential adverse effects through avoidance, minimization, or mitigation.

The following discussion of environmental impacts is not limited to historic properties and includes potential impacts to cultural resources, regardless of their NRHP eligibility.

Road Impacts

No Action Alternative Impacts

The No Action Alternative would not result in impacts to cultural resources. Ongoing small-scale mineral development and ore exploration would continue to influence the affected environment for cultural resources.

Impacts Common to All Action Alternatives

The proposed road could result in direct and indirect impacts to cultural resources during each phase of construction (including impacts during ice road construction for aboveground cultural resources) and during road closure and reclamation.

[76] Historic properties are defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places . . . ." 36 CFR 800.16(l)(1).

Direct impacts to cultural resources include physical destruction or damage of a property, removal of a property from a historic location, change in the character of use or physical features that contribute to historic significance, deterioration through neglect, or introduction of visual, atmospheric, or audible elements that diminish the integrity of a property's significant historic features (36 CFR 800.5(a)(2)). Direct impacts include all physical impacts to resources, regardless of their specific type (i.e., whether they are visual, physical, auditory, etc.).

Indirect impacts to cultural resources are more varied and could include those caused by the project that are later in time or farther removed in distance but are still reasonably foreseeable. While the road would be closed to general public access, indirect impacts could include increased access to areas with cultural resources from unauthorized users or construction workers, resulting in possible damage, looting, or loss of privacy. Indirect impacts could also include changes to the physical environment that structurally affect the resource, such as through permafrost thawing and vibration from construction. Some indirect impacts may be short term (i.e., limited to the construction or operation phases), but others may be longer term (e.g., loss of resource or changes to patterns of use, such as for ethnographic resources).

AHRS sites and RS2477 trails are located within the APEs for all action alternatives. Therefore, direct and indirect impacts to cultural resources, including previously undiscovered or unreported cultural resources, are likely under all action alternatives. As shown in Appendix F, Tables 40 through 42, the archaeological resources probability model (Sweeney and Simmons 2019) indicates nominal differences in the estimated percentages of high, medium, and low probability areas among the alternatives for the occurrence of prehistoric or proto-historic resources but substantial differences in acreages. The tables help to illustrate the likelihood and magnitude of impact. This model is limited by the number of (or lack of, in some instances) previous archaeological investigations that have been conducted in the area. However, the PA (see Appendix J) addresses the process for identifying historic properties and resolving potential effects to these properties. While the stipulations included in the PA are intended to mitigate adverse effects to historic properties, they would also mitigate effects to cultural resources as they are defined in NEPA through avoidance measures. This includes requiring cultural resource surveys to occur prior to ground-disturbing activities and requiring all construction personnel to undergo cultural awareness training.

Cultural and ethnographic ties to the study area are evidenced by cultural sites (ADNR, Office of History and Archaeology 2023), place names (Smith 2021), traditional and contemporary uses (Skinner 2023; Watson 2018; see Section 3.4.7, Subsistence Uses and Resources), oral histories (Skinner 2023), and current beliefs and values (see scoping comments for the Supplemental EIS). When these are viewed as a whole, these ties to land and place could be identified by local people as TCPs and/or cultural landscapes and subsequently documented as such in the scope of the cultural resource regulatory framework. These types of cultural resources have not been documented to date in the study area under the existing regulatory frameworks, although the wide array of individual place names, traditional use areas, AHRS sites, and interviews identified cultural resources, including the Kobuk Sacred Site (see Skinner 2023), in the study area demonstrate the potential for these ethnographic resources, such as TCPs and cultural landscapes, to be documented.

While potential impacts on specific cultural resource sites would differ by alternative (see discussion below), broader cultural impacts on belief systems/religious practices, traditional uses, areas, resources, and cultural ties would be similar across all alternatives (see also the discussion in Section 3.4.7, Subsistence Uses and Resources, and Appendix L). Iñupiat, Koyukon, and Tanana Athabascan peoples have traditional and current cultural ties to the study area and the resources that move through it and hold locations within the study area as sacred to their culture (see Allakaket Village 2022; BLM 2015; Huslia Tribe 2022; Skinner 2023). The presence of development in the study area would introduce a cultural

impact to these groups because they believe that development would harm the waterways and fish, caribou, and other resources. Any potential impacts on the resources would constitute a cultural effect:

> We have thousands of years of soul ties to the land and animals that we have respected in order for it to give back to us. The Ambler road does no good for the original stewards of the land, the Native people. We deserve a say in this direct attack on our land and animals. Please hear us and try to understand how this effects many. (Scoping comment for Supplemental EIS)
>
> This road project is of high interest to the Tribe due to the potential impacts to critical and treasured fish and wildlife resources that our members depend on for their cultural, nutritional, and spiritual way of life (Native Village of Kotzebue scoping comment for Supplemental EIS)

In summary, given the ethnographic information currently available of the cultural importance of the study area, potential impacts on traditional belief systems/religious practices and other ethnographic resources, such as TCPs and cultural landscapes, would be adverse, regional, and long term. This is based on the Indigenous knowledge that large-scale ethnographic resources such as culturally valued waterways and subsistence resources would be impacted if an action alternative is chosen. Continued consultation with the Tribes during the NEPA and Section 106 processes would continue to explore options for minimization and mitigation measures related to ethnographic resources.

Alternative A Impacts

Based on the information available, Alternative A could affect the greatest number of documented cultural resources. However, the higher number of documented cultural resources along this route is likely due to more archaeological investigations conducted along this route within GAAR and from recent Ambler Access Project–related surveys. There are 309 previously recorded AHRS sites within the Alternative A study area and 10 RS2477 trails (see Appendix F, Tables 35 and 37). Within the ROW corridor there are 12 AHRS sites and 6 RS2477 trails that could be affected (see Appendix F, Table 36 and 37). The majority of the AHRS sites within the ROW consist of prehistoric chipped stone scatters, although 3 sites are transportation features, including the Slate Creek to Stevens Village Winter Trail and a section of the abandoned Hickel Highway. If avoidance is not possible, these sites within the proposed ROW corridor would be the most likely to be destroyed or damaged from construction activities. These sites, particularly those with visible artifacts, would also be the most susceptible to effects from increased access, including potential looting or damage from construction workers or maintenance and operations personnel.

While other sites within the study area outside the ROW would be less likely to be destroyed or damaged from construction activities, the project could introduce dust, visual, and audible (and potentially olfactory from truck exhaust, other airborne contaminates, or spills) effects (hereafter referred to as sensory effects) that could impact sites within the 10-mile-wide study area. While there could be exceptions such as archaeological sites where Indigenous communities return to pass on traditional knowledge (i.e., ethnographic resources), in general, these sensory impacts to setting and feeling would be less likely to affect archaeological sites and historic isolates (e.g., piece of modified wood) in the area because their cultural importance and information potential would not be affected. Built environment resources like structures, cabins, and camps, in addition to ethnographic resources, would be more likely to experience sensory impacts to setting and feeling that could impact the resource. Filtering out prehistoric and paleontological site types from the AHRS resulted in 56 of 305 AHRS sites within the Alternative A study area that could be more susceptible to these types of sensory effects.

Ethnographic resources reported in Skinner (2023) that are within the Alternative A study area that could experience sensory effects include several camps; traditional bear, sheep, and trapping areas; 3 portages; a

traditional use area near a Native allotment; a place of cultural transmission at a Native allotment; a traditional trail; a historic caribou hunting area; a dugout/hideout location; and a Sacred Site. Lastly, the Jim River ACEC Expansion nomination area is crossed by Alternative A and the nominated Koyukuk River Tributaries ACEC and Huslia ACEC are downstream of this alternative. Based on Smith and Kari (2023) data set, there are 16 line place names within the Alternative A ROW corridor (see Appendix F, Table 36). Within the Alternative A 10-mile-wide study area, there are 35 points and 45 lines, some of which are duplicates of each other (e.g., point and line feature for the same place name of Kobuk River) (see Appendix F, Table 35).

The location of cultural resources in the direct and indirect APEs indicates the possibility for direct and indirect impacts. The likelihood for encountering previously undocumented cultural resources and historic properties within the APE is high. Archaeological probability modeling suggests that the Alternative A APE contains extensive high and medium probability zones for cultural resources (see Appendix F, Table 40 provides a sense of the likelihood and magnitude of impact).

Alternative B Impacts

There are 148 previously recorded AHRS sites within the Alternative B study area and the same RS2477 trails as Alternative A (see Appendix F, Tables 35 and 37). Within the ROW corridor there are 7 AHRS sites and 6 RS2477 trails that could be affected (see Appendix F, Tables 36 and 37). Four AHRS sites within the ROW consist of prehistoric chipped stone scatters, 1 fossilized mammoth tooth, the Slate Creek to Stevens Village Winter Trail, and a section of the abandoned Hickel Highway. If avoidance is not possible, these sites within the proposed ROW corridor would be the most likely to be destroyed or damaged from construction activities. These sites, particularly those with visible artifacts, would also be the most susceptible to effects from increased access, including potential looting or damage from construction workers or maintenance and operations personnel. Filtering out prehistoric and paleontological site types from the AHRS resulted in 27 of 148 AHRS sites within the Alternative B study area that could be more susceptible to sensory effects. Nominated ACECs and interviews identified ethnographic resources reported in Skinner (2023) that are within the Alternative B study area are the same as Alternative A. Based on Smith and Kari (2023) data set, there are 18 line place names within the Alternative B ROW corridor (see Appendix F, Table 36). Within the Alternative B 10-mile-wide study area, there are 35 points and 47 lines, some of which are duplicates of each other (see Appendix F, Table 35).

The extent and duration of direct impacts to AHRS sites in the Alternative B APE would be similar to those described for Alternative A, although fewer resources have been identified to date. The probability is high that previously undocumented cultural resources and historic properties exist within the Alternative B APE. Archaeological probability modeling suggests that the Alternative B direct and indirect APEs contain extensive high and medium probability zones for cultural resources (see Appendix F, Table 41, provides a sense of the likelihood and magnitude of impact).

Alternative C Impacts

There are 62 previously recorded AHRS sites within the Alternative C study area and 10 RS2477 (see Appendix F, Tables 35 and 37). Within the ROW corridor there are 5 AHRS sites and 7 RS2477 trails that could be affected (see Appendix F, Tables 36 and 37). The 5 AHRS sites within the ROW corridor include 2 historic transportation routes, a historic prospecting camp, a portion of the Dalton Highway, and a prehistoric artifact scatter. If avoidance is not possible, these sites within the proposed ROW corridor would be the most likely to be destroyed or damaged from construction activities. These sites, particularly those with visible artifacts, would also be the most susceptible to effects from increased access, including potential looting or damage from construction workers or maintenance and operations personnel. Filtering

out prehistoric and paleontological site types from the AHRS resulted in 39 of 62 AHRS sites within the Alternative C study area that could be more susceptible to sensory effects. Nominated ACECs and interviews identified ethnographic resources reported in Skinner (2023) that are within the Alternative C study area include a historic trail, the Koyukuk River Tributaries ACEC, and the Huslia ACEC. Based on Smith and Kari (2023) data set, there are 26 line and 1 point place names within the Alternative C ROW corridor (see Appendix F, Table 36). Within the Alternative C 10-mile-wide study area, there are 94 points and 69 lines, some of which are duplicates of each other (see Appendix F, Table 35).

Potential direct and indirect impacts to these resources would be the same as those described for Alternatives A and B, although fewer resources have been identified to date. While Alternative C would affect the least amount of currently documented resources, this is likely due to the relative absence of archaeological investigations along the route, given the recent focus on conducting cultural resource surveys within the right-of-way corridor approved in the previous 2020 ROD. Archaeological probability modeling suggests that the Alternative C APE contains extensive high and medium probability zones for cultural resources (see Appendix F, Table 42, provides a sense of the likelihood and magnitude of impact). Therefore, the probability is high that previously undocumented cultural resources and historic properties exist within the Alternative C APE.

Combined Phasing Option

Combined phasing of an action alternative would generally result in the same impacts as described above for each of the alternatives. The reduction in construction from 3 to 4 years to 2 to 3 years would lessen the duration for construction-related noise impacts to culturally sensitive areas and resources as well as shorten the length of time for potential increased access impacts from construction workers.

Mining, Access, and Other Indirect and Cumulative Impacts

The anticipated mining scenario would result in the development of several large mining projects in the District. These projects would include actions such as infrastructure development and the excavation of open pit mines over large areas. The projects would carry a high potential for additional direct and indirect impacts to cultural resources, although the specific locations and time frames for individual projects are unknown. Few cultural resources investigations in the District have previously occurred. Additional mining impacts could result from development of mining projects outside the District along all action alternatives. Development of the mines would require additional evaluation and consultation to comply with the NHPA prior to their approval.

Other development infrastructure projects (e.g., Dalton Highway improvements, OTZ Telephone Cooperative communication towers, Willow Master Development Plan within the NPR-A, Port of Nome Expansion Project, Port of Alaska Modernizations, and the Manh Choh Mine), as well as changes in land management (e.g., ANCSA 17(d)(1) Withdrawals EIS), could result in additional impacts to cultural resources. Improvements to the Dalton Highway may be needed due to increased industrial traffic resulting from future mining development and arctic oil development, which could cumulatively result in a greater quantity of Dalton Highway improvements (e.g., widening or realignment), increasing the probability for direct and indirect impacts to cultural resources and to the NRHP-eligible Dalton Highway itself. Changes in land management from federal to state or Native corporations could result in fewer regulatory protections for cultural resources (e.g., Section 106 of the NHPA) resulting in increased likelihood for impacts to cultural resources in those areas. An additional reasonably foreseeable action is the closure of the Red Dog Mine in the 2030s. No additional impacts to cultural resources are anticipated from the closure of the Red Dog Mine.

While the currently proposed road is an industrial access only road, the BLM assumes that there will be some potential use of the road by unauthorized users. Unauthorized use would likely increase impacts, including damage to sites, looting, intrusion into culturally important or sacred areas. Unauthorized users would also be more likely to fail to implement minimization measures resulting in higher cultural effects on local residents from damage to traditional and culturally valued use areas associated with trail developments by ORVs, left-behind garbage, and increased chances for wildfires from unattended campfires.

In addition to unauthorized user access, the BLM has identified reasonably foreseeable public and non-industrial access of the Ambler Road. This access could include local residents' use of the Ambler Road for subsistence use, commercial use of the road for local community purposes, access for individuals with existing land use rights, and potential development as a public road to benefit all Alaskans. Authorized public use of the road for local residents' subsistence use, commercial benefits for local communities, and for individuals with existing land use rights in the future would incrementally increase the potential for cultural effects of similar nature to those discussed under unauthorized use (see preceding paragraph). However, authorized public use of the road for all Alaskans would certainly result in use of the road corridor by non-local hunters, recreationalists, and tourists, substantially increasing the magnitude and likelihood of cultural impacts related to damage to sites, looting, and intrusion in to culturally important or sacred areas. Additional cumulative impacts tied to subsistence and culturally valued traditional harvest and use practices are discussed in Section 3.4.7, Subsistence Uses and Resources.

As a result of climate change, environmental changes such as permafrost melt could result in relocation or modification of facilities and infrastructure associated with the access road and mining projects. Such actions could result in direct and indirect impacts to cultural resources.

3.5. Short-Term Uses versus Long-Term Productivity

This section discusses the relationship of local, short-term impacts and uses of resources that would occur if the Ambler Road were authorized, and the maintenance and enhancement of long-term productivity of the project area's environmental resources. Short-term uses of the environment generally are understood to be the impacts of the project, compared to long-term productivity of various resources.

In this section, short-term refers to the total duration of the activities described in Chapter 2, Alternatives, and includes the mining development and community access activities described in Appendix H. Generally, this period is anticipated to be 50 years, which is the duration of AIDEA's requested ROW authorization. Each of the action alternatives would involve varying degrees of the short-term uses of resources through the conversion of natural areas to road ROW. Productivity of the land as a natural and recreational resource would be affected as part of a transportation facility for the life of the proposed project. Short-term impacts are described in Sections 3.2, Physical Environment, through 3.4, Social Systems.

Long-term productivity refers to an indefinite period after mining in the District is complete and the road has been removed and reclaimed. Over the long term, decades after the cessation of mining and reclamation of the road, environmental conditions and productivity are generally expected to recover. In the Arctic, recovery can take longer than in other environments, and recovery does not mean the productivity would return to original conditions. At the mine sites and certain damaged areas where water courses may have been altered or permafrost accidently melted, recovery is less likely. Other reasonably foreseeable actions, such as rising temperatures, could continue to influence change in the productivity of the project area in both the short and long term.

3.6. Irreversible and Irretrievable Commitments of Resources*

Irreversible and irretrievable commitments of resources refers to impact to or use of resources that cannot be reversed or recovered. Such commitments refer primarily to nonrenewable resources. There would be irreversible and irretrievable commitments of resources associated with any of the action alternatives, including:

- Use of gravel resources for construction of the road, maintenance camp pads, and airstrips. Gravel resources are considered to be in limited supply along much of the Dalton Highway. Along the proposed route, this also is likely to be the case, especially for gravels not containing NOA.
- Ground disturbance and permanent change to permafrost, and associated topography and vegetation changes, that would be expected to occur with gravel extraction and road cuts.
- Use of fuel for energy during road construction, operation, and reclamation.
- Use of concrete and steel resources for bridges, culverts, and buildings. These resources are not known to be scarce but likely would be transported long distances to reach the project site. Steel is anticipated to be recycled to the extent it is still useable after 50 years.
- Change of land use to transportation purposes, with partial recovery of land uses at closure and reclamation.
    - Reduction or change of vegetation and wetlands, which also serve as wildlife habitat, where gravel is removed or placed.
    - Reduction or abandonment of wildlife habitat.
    - Reduction or change of subsistence use areas.
    - Reduction or change of cultural resources and uses.
- Loss of a large tract of undeveloped and unfragmented land having wilderness characteristics. This would occur during the life of the project, with partial but not complete recovery thereafter because the linear visual change on the ground after road closure and reclamation would persist.
- Commitment of financial resources for road construction.

In general, the longer the alternative, the greater the commitment of resources to establish and maintain the road. Therefore, Alternatives A and B would have similar commitments of resources, and Alternative C would have greater commitments. The combined phasing option would generally result in the same commitment of resources under each of the action alternatives but would alter the timing of those commitments to occur within a shorter period of time due to the condensed construction schedule. These changes and impacts are discussed in 3.2, Physical Environment, through 3.4, Social Systems, and some quantities appear in Appendix C, Tables 1 and 2, which summarize impacts of the alternatives.

As indirect (induced) impacts of road construction, the mining scenario described in Appendix H also would result in irreversible and irretrievable commitments of resources, including use of marketable mineral resources such as copper and gold. Other irreversible and irretrievable mine impacts would be similar to those bulleted above for the road, would be in addition to those for the road.

Appendix A. Figures

(Figures for Chapters 1–3)

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1. Introduction

Chapter 1, Introduction, includes no figures.

2. Alternatives

Figure 2-1 shows a typical cross section of the proposed road.

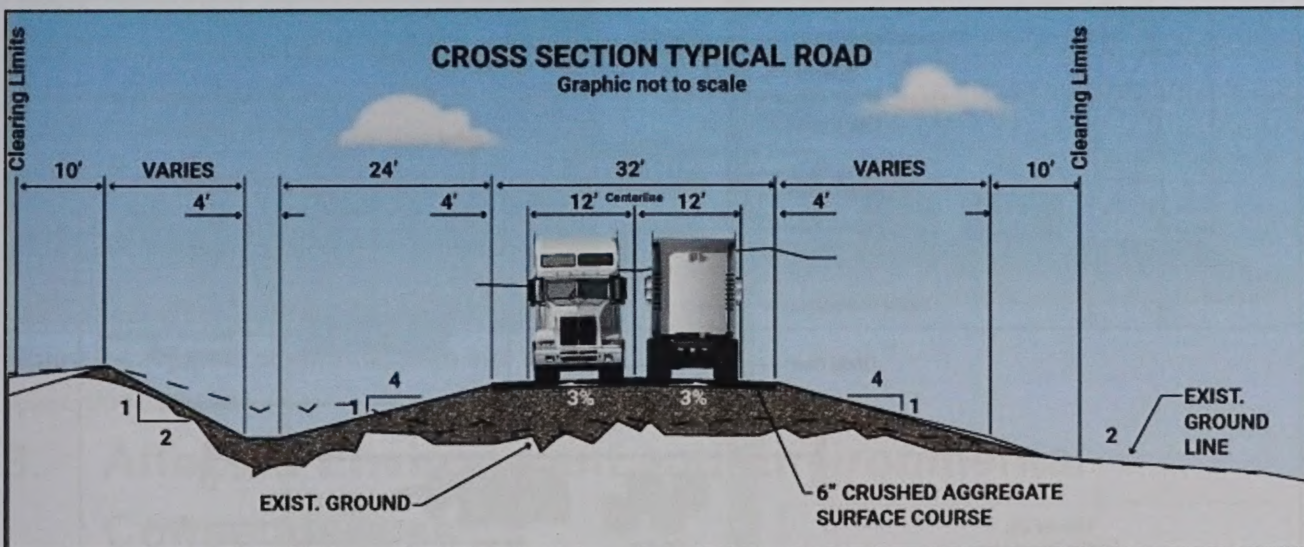


Figure 2-1. Typical roadway section

Source: Adapted from DOWL 2016: Appendix 5C Typical Section

Figure 2-2 depicts a typical truck and container system.

Figure 2-2. Typical vehicle with containerized concentrate

Source: Trilogy Metals 2018

Figure 2-3 illustrates typical maintenance station facilities.

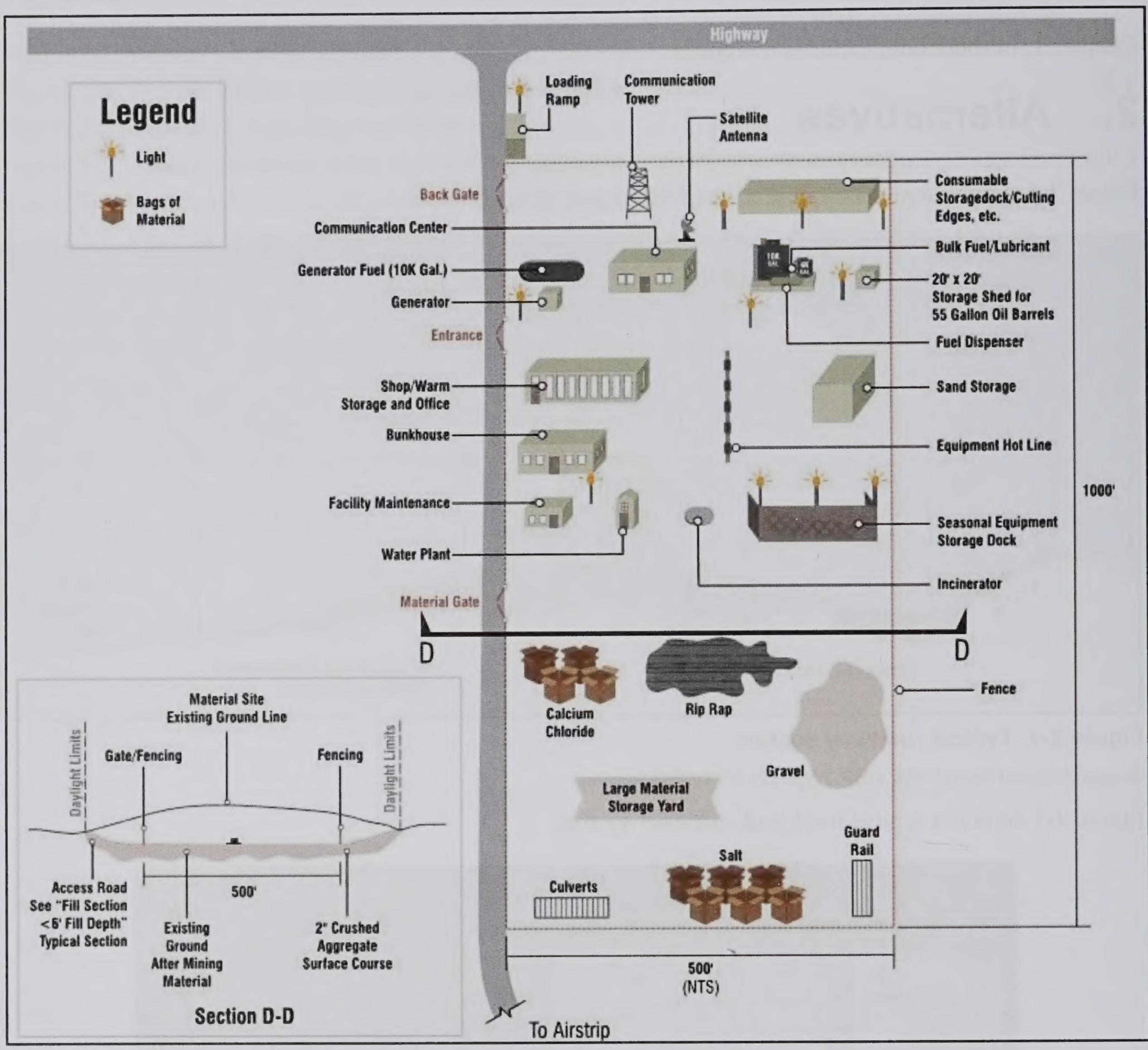


Figure 2-3. Typical maintenance station layout

Source: DOWL 2019

Figure 2-4 illustrates proposed communications facilities.

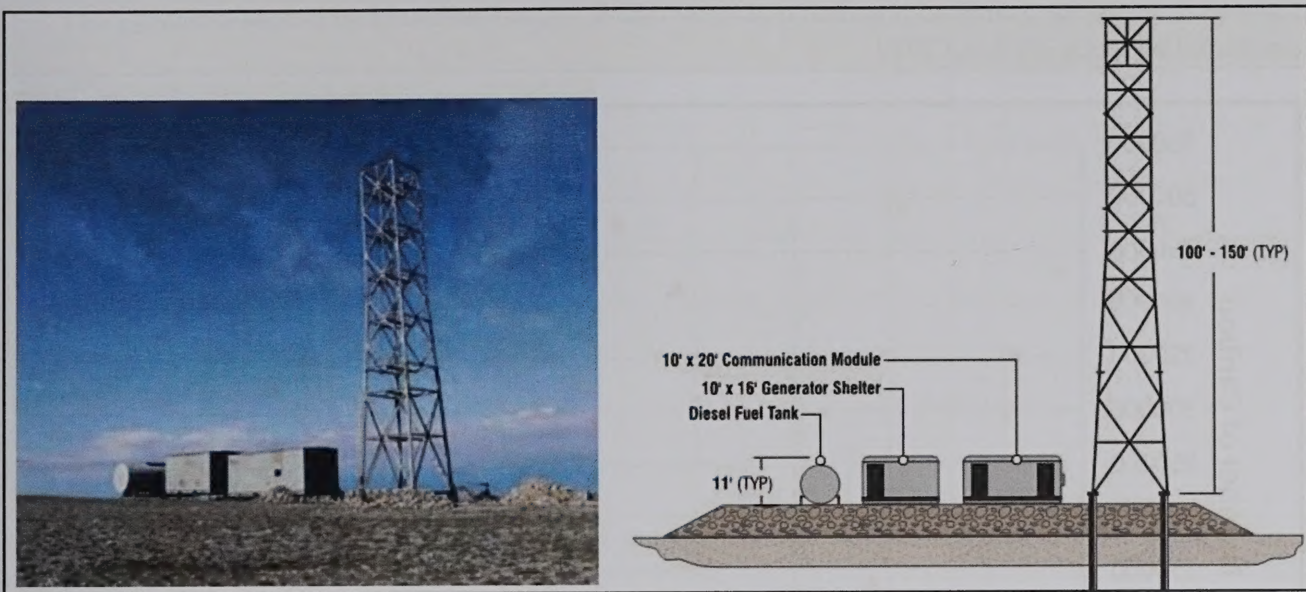


Figure 2-4. Typical communication site layout

Source: DOWL 2019

3. Affected Environment and Environmental Consequences

3.1. Introduction

Section 3.1, Introduction, includes no figures.

3.2. Physical Environment

Section 3.2, Physical Environment, includes no figures. See Appendix D, Attachment A, for figures regarding noise.

3.3. Biological Environment

3.3.1 Vegetation and Wetlands

Section 3.3.1, Vegetation and Wetlands, includes no figures.

3.3.2 Fish and Amphibians

Section 3.3.2, Fish and Amphibians, includes no figures.

3.3.3 Birds

Section 3.3.3, Birds, includes no figures.

3.3.4 Mammals*

Figure 3-1 shows the estimated population of the Western Arctic Caribou Herd based on surveys conducted between 1970 and 2022.

Figure 3-1. Western Arctic Caribou Herd population estimates from 1970 to 2022*

Source: Dau 2015, Western Artic Caribou Herd Working Group 2022

Figure 3-2 shows the estimated population of the Ray Mountains and Hodzana Hills caribou herds based on surveys conducted between 1991 and 2011.

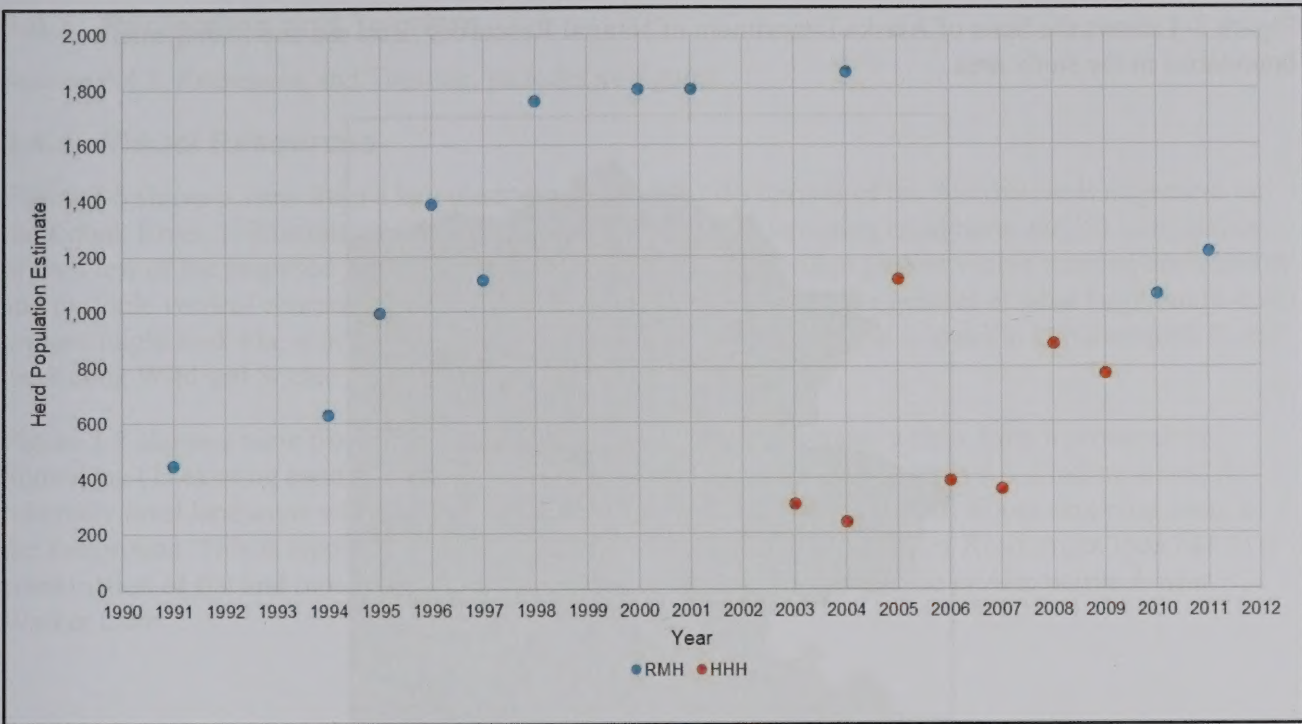


Figure 3-2. Ray Mountains and Hodzana Hills Caribou Herds population estimates from 1991 to 2011*

Source: Pamperin 2015
Note: RMH = Ray Mountains herd; HHH = Hodzana Hills herd

3.4. Social Environment

3.4.1 Land Ownership, Use, Management, and Special Designations

Figure 3-3 shows the Bureau of Land Management's land use and management boundaries in the study area.

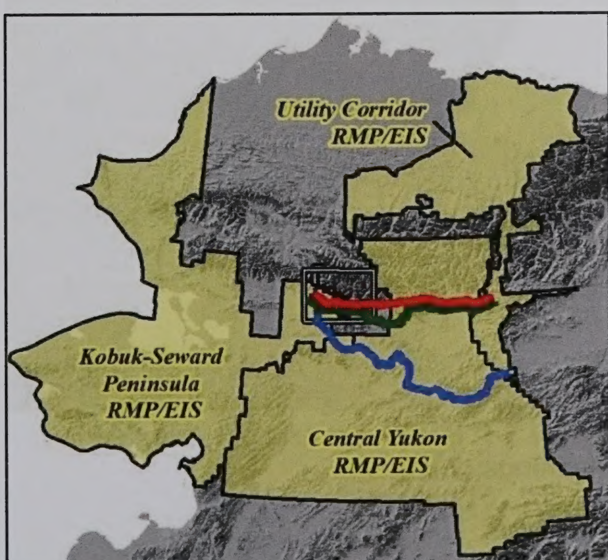


Figure 3-3. Bureau of Land Management Resource Management Plan boundaries

Source: HDR 2019

Figure 3-4 shows the State of Alaska Department of Natural Resources' land use and management boundaries in the study area.

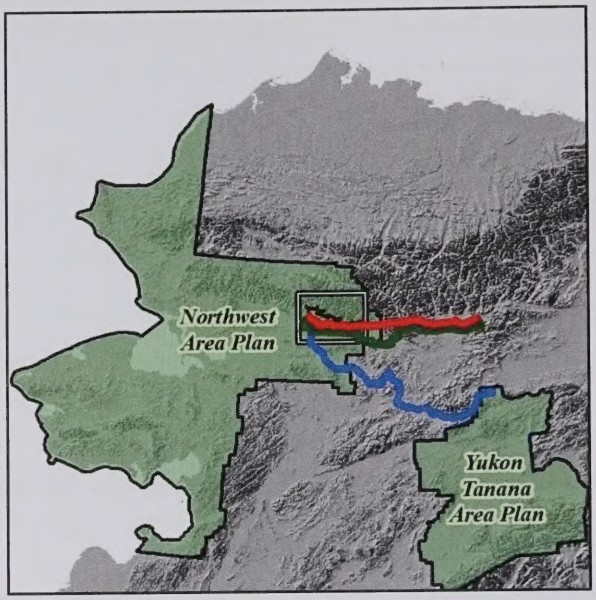


Figure 3-4. State of Alaska Department of Natural Resources Area Plan boundaries

Source: HDR 2019

Figure 3-5 shows the Northwest Arctic Borough's land use and management boundaries in the study area.

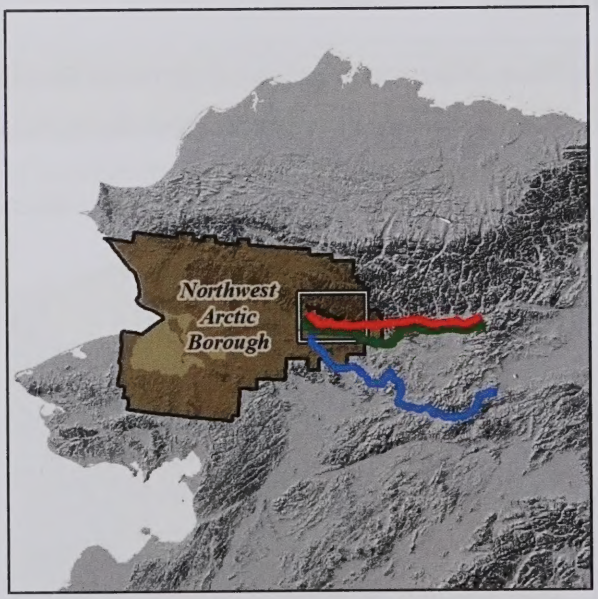


Figure 3-5. Northwest Arctic Borough planning boundary

Source: HDR 2019

3.4.2 Transportation and Access

Section 3.4.2, Transportation and Access, includes no figures.

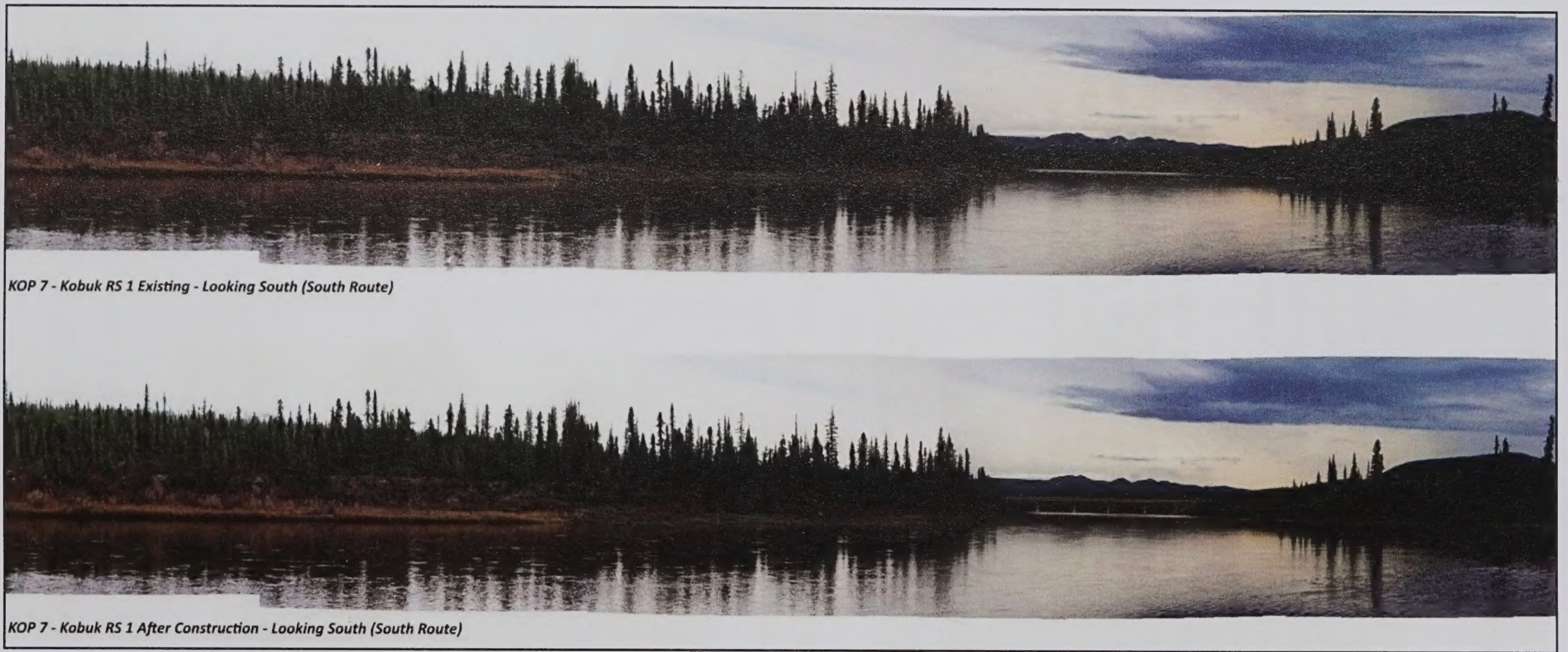
3.4.3 Recreation and Tourism

Section 3.4.3, Recreation and Tourism, includes no figures.

3.4.4 Visual Resources

Figure 3-6 shows a view from a key observation point (KOP) upriver of the Alternative B alignment on the Kobuk River. It illustrates a river-level view. Shown are (1) existing conditions and (2) a simulation of the view of the proposed Kobuk River bridge, with concrete bridge girders visible running horizontally and multiple vertical concrete piers in the river. This is representative in general of what large, multi-span bridges might look like at any major river crossing on any alternative but is specific to Alternative B and the Kobuk Wild and Scenic River.

Figure 3-7 shows a view from a KOP west of Walker Lake. It illustrates a view from a promontory. Shown are (1) existing conditions and (2) a simulation of the view of Alternative A winding across a relatively level landscape with moderate mountains in the background and hill slopes dropping away in the foreground. This is representative in general of what the proposed Ambler Road might look like in a combination of flat and mountainous terrain on any alternative but is specific to Alternative A near Walker Lake.



KOP 7 - Kobuk RS 1 Existing - Looking South (South Route)

KOP 7 - Kobuk RS 1 After Construction - Looking South (South Route)

Figure 3-6. Example visual simulation—river crossing

Source: DOWL 2014

KOP 3 - ROW West High Existing - Looking Southeast (North Route)

KOP 3 - ROW West High After Construction- Looking Southeast (North Route)

Figure 3-7. Example visual simulation—road on the landscape

Source: DOWL 2014

3.4.5 Socioeconomics and Communities

Section 3.4.5, Socioeconomics and Communities, includes no figures.

3.4.6 Environmental Justice

Section 3.4.6, Environmental Justice, includes no figures.

3.4.7 Subsistence Uses and Resources

Section 3.4.7, Subsistence Uses and Resources, includes no figures.

3.4.8 Public Health

Section 3.4.8, Public Health, includes no figures.

3.4.9 Cultural Resources

Section 3.4.9, Cultural Resources, includes no figures.

4. References*

Dau, J. 2015. Units 21D, 22B, 22C, 22E, 23, 24 AND 26A. Chapter 14, p. 14-1 through 14-89 In: *Caribou management report of survey and inventory activities 1 July 2012 – 30 June 2014* (P. Harper and L.A. McCarthy, eds.). Alaska Department of Fish and Game Species Management Report ADF&G/DWC/SM-2015-4. Juneau, Alaska.

DOWL. 2014. *Preliminary Visual Impact Analysis, Ambler Mining District Industrial Access Road.* November 2014. Prepared for AIDEA by DOWL. Anchorage, Alaska. Available at: ftp.ambleraccess.org/Reports/Project_Field_Studies/2014/01_Appdx_3C-Visual_Analysis_Report.pdf.

DOWL. 2016. *Ambler Mining District Industrial Access Road SF299 Revised Permit Application.* Appendix 5C Typical Section (June 29, 2016). Available at: eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=111130.

DOWL. 2019. Ambler Mining District Industrial Access Project SF299 Application Communications Amendment. April 2019. Prepared for AIDEA by DOWL. Anchorage, Alaska.

Pamperin, N.J. 2015. Units 20F, 21B, 21C, 21D, 24A, 24B, and 25D caribou. Chapter 13, pages 13-1 through 13-15 In: *Caribou management report of survey and inventory activities 1 July 2012–30 June 2014* (P. Harper and L. A. McCarthy, editors). Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2015-4. Juneau, Alaska.

Trilogy Metals Inc. 2018. High Grade, High Quality, Solid Partners: Copper-Zinc-Lead-Gold-Silver and now… Cobalt. 2018 Precious Metals Summit Colorado, presentation dated September 21, 2018. Available at: trilogymetals.com/assets/docs/presentations/Trilogy-Metals---Corporate-Presentation----Precious-Met.pdf.

Western Arctic Caribou Herd Working Group. 2022. Research and Monitoring, Caribou Census. Available online at: https://westernarcticcaribou.net/contactalaska-fish-game/links/research-and-monitoring/#:~:text=Caribou%20Census%3A%20The%20Alaska%20Department,population%20estimate%20of%20164%2C000%20animals. Accessed August 2022.

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1.1. Introduction

This section includes no tables or supplemental information.

1.2. Project Background and Overview

This section includes no tables or supplemental information.

1.3. Applicant's Purpose and Need for the Project

This section includes no tables or supplemental information.

1.4. Purpose and Need for Federal Action

This section includes no tables or supplemental information.

1.5. Collaboration and Coordination*

Table 1 summarizes key anticipated authorizing laws, regulations, and permits for the project.

Table 1. Key permits, approvals, and other requirements by agency*

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
DOI BLM and federal cooperating agencies	NEPA	Disclose and review environmental impacts of proposed federal actions
DOI BLM/federal cooperating agencies	NHPA	NHPA consultation, Section 106 determinations/PA includes consideration of effects of federal undertakings on historic properties
DOI BLM	FLPMA	Decision whether to grant ROW permit and authorization to regulate the use, occupancy, and development of public lands and to take action to prevent unnecessary or undue degradation of public lands
DOI BLM	ANILCA Section 201 and Title XI	ANILCA-defined conservation system units and Authorization for Transportation and Utility Systems and Facilities on Federal Lands
DOI BLM	ANILCA Section 810	Section 810 evaluation and findings include analysis of impacts to subsistence resources and access to those resources
DOI BLM	ANCSA	Coordination with ANCSA landowners (DOI Policy on Consultation with Alaska Native Claims Settlement Act Corporations [2011])
DOI NPS	ANILCA Section 201(4)(b)	Grant ROW permit across GAAR if BLM selects a route that goes through GAAR
USACE	CWA Section 404	Department of the Army Permit for discharge of dredged or fill material into waters of the United States, including wetlands
USACE	Rivers and Harbors Act Section 10	Department of the Army Permit for construction in any navigable water; the excavation or discharge of material into such water; or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
USCG	Rivers and Harbors Act Section 9	Section 9 permit for development of a bridge or causeway in or over any navigable river or navigable water of the United States
DOI USFWS	Bald and Golden Eagle Protection Act	Permits to take, haze, relocate, or destroy eagles or their nests
DOI USFWS	MBTA	Consultation/permits for actions that could take migratory birds or the parts, nests, or eggs of such birds
DOI USFWS	Fish and Wildlife Coordination Act	Consultation on impacts on fish and wildlife resources
NMFS	MSA	EFH Assessment: consultation on the effects to EFH
ADEC	CWA Section 401	Section 401 Water Quality Certification issued to accompany the USACE Section 404 permit
ADEC	CWA Section 402	APDES permit for point-source discharge of wastewater or storm water into waters of the United States
ADEC	Title I and/or Title V Operating Permits 18 AAC 50	Construction, Minor Permit, or Operating permits for air pollution sources at material sites and or construction/maintenance camps
ADF&G	AS Title 16	Title 16 Fish Habitat Permit required for proposed activity conducted below mean high water of anadromous fish streams
ADNR	AS 38.05.850	Road ROW permit for state land
ADNR	AS 38.05.550-565	Material sales (e.g., gravel) permit for state land
ADNR	AS 38.05.850	Land use permits for any construction camps, staging areas, and airstrips that may be outside the construction ROW on state land
ADNR	AS 46.15 and 11 AAC 93	Temporary water use/water rights
SHPO	AS 41.35 (AHPA); NHPA Section 106	AHPA and NHPA Section 106 review of activities that may affect cultural resources/historic properties
NAB	NAB Home Rule Charter Title 9	Borough permitting
DOI BLM/federal cooperating agencies	EO 11988	Floodplain Management: avoid short- and long-term adverse impacts to wetlands whenever a practicable alternative exists
DOI BLM/federal cooperating agencies	EO 11990	Protection of Wetlands: minimize the destruction, loss, or degradation of wetlands, and preserve and enhance the natural and beneficial values of wetlands
DOI BLM/federal cooperating agencies	EO 12898	Environmental Justice: identify/address disproportionately high and adverse effects of the project on minority and low-income populations
DOI BLM/federal cooperating agencies	EO 13045	Protection of Children from Environmental Health and Safety Risks: identify/assess environmental health and safety risks that may disproportionately affect children
DOI BLM/federal cooperating agencies	EO 13112	Invasive Species: prevent the introduction of invasive species; control invasive species already introduced; and minimize the economic, ecological, and human health impacts of invasive species
DOI BLM/federal cooperating agencies	EO 13175	Consultation and Coordination with Indian Tribal Government: consult with tribal governments when considering polices that would impact tribal communities

Responsible agency	Jurisdiction/legal authority	Key permit, approval, or other requirement
DOI BLM/federal cooperating agencies	EO 13990	Public Health and Climate: listen to the science; improve public health and protect our environment; ensure access to clean air and water; reduce GHG emissions; and bolster resilience to the impacts of climate change. Consider and use all tools and resources available in assessing GHG emissions and climate change effects and take appropriate action to ensure consistency with the policy articulated in the EO.
DOT&PF	17 AAC 10	Driveway/Approach Road permit for connecting to existing DOT&PF road
DOT&PF	17 AAC 20	Lane Closure Permit for Dalton Highway lane closures (if needed during construction)

Notes: AAC = Alaska Administrative Code; ADEC = Alaska Department of Environmental Conservation; ADF&G = Alaska Department of Fish and Game; ADNR = Alaska Department of Natural Resources; AHPA = Alaska Historic Preservation Act; ANCSA = Alaska Native Claims Settlement Act; ANILCA = Alaska National Interest Lands Conservation Act; APDES = Alaska Pollutant Discharge Elimination System; AS = Alaska Statute; BLM = Bureau of Land Management; CWA = Clean Water Act; DOI = Department of the Interior; DOT&PF = Alaska Department of Transportation and Public Facilities; EFH = Essential Fish Habitat; EO = Executive Order; FLPMA = Federal Land Policy and Management Act; GAAR = Gates of the Arctic National Park and Preserve; MBTA = Migratory Bird Treaty Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NAB = Northwest Arctic Borough; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; NPS = National Park Service; PA = Programmatic Agreement; ROW = right-of-way; SHPO = State Historic Preservation Officer; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USFWS = U.S. Fish and Wildlife Service EIS Development Process and Coordination

1.6. EIS Development Process and Coordination

This section includes no tables or supplemental information.

2. References

None cited.

Appendix C. Chapter 2 Alternatives Tables and Supplemental Information

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1.1. Introduction

No tables or supplemental information.

1.2. Alternatives Development Process

No tables or supplemental information.

1.3. Alternatives Considered but Eliminated from Detailed Analysis

No tables or supplemental information.

1.4. Alternatives Retained for Detailed Analysis

Table 1 provides a summary of key project components by alternative to supplement the text in Section 2.4.3 of the Supplemental EIS, Features Common to All Action Alternatives. This table shows how the common features differ in number or extent across the alternatives.

Table 1. Summary of major project components for each action alternative*

Component	Alternative A	Alternative B	Alternative C
Terminus (project start)	MP 161 Dalton Highway	MP 161 Dalton Highway	MP 59.5 Dalton Highway
Terminus (project end)	Ambler River/Ambler Mining District	Ambler River/Ambler Mining District	Ambler River/Ambler Mining District
Length of industrial access road (miles)	211	228	332
Total footprint of industrial access road (acres)	2,318	2,551	5,262
Total footprint of support access roads (acres)	137	214	239
Number of maintenance stations (12 acres each)	4 stations (48 acres)	4 stations (48 acres)	5 stations (60 acres)
Number of material sites	41	46	44
Total footprint of material sites (acres)	1,863	2,155	2,408
Number of airstrips (150 feet by 3,000 feet)	3	3	5
Total footprint of airstrips (acres)	153	153	255
Number of vehicle turnouts (1 every 10 to 11 miles)	20	22	32
Number of communications towers: At maintenance stations + At materials sites = Total number	3 + 9 = 12	3 + 10 = 13	5 + 14 = 19
Total footprint of project (acres)	4,524	5,138	8,210
Total footprint of project on NPS-managed lands (acres)	332	343	0
Gravel needed for construction (cubic yards)	15 million	16.8 million	22 million
Gravel needed for maintenance (cubic yards, annually)	220,000	238,000	347,000
Number of minor culverts (to 3 feet wide)	2,864	3,150	4,076
Number of moderate culverts (4 to 10 feet wide)	7	5	131
Number of major culverts (10 to 20 feet wide)	12	9	141
Number of small bridges (less than 50 feet long)	22	18	79
Number of medium bridges (50 to 140 feet long)	16	12	158
Number of large bridges (greater than 140 feet long)	11	11	14

Component	Alternative A	Alternative B	Alternative C
Costs* of construction (based on 2-lane road):			
Road	$578.8 million	$622.8 million	$1.14 billion
Landing strips (number of strips)	$3.2 million (3)	$3.2 million (3)	$5.4 million (5)
Maintenance stations (number of stations)	$34.2 million (4)	$34.2 million (4)	$51.4 million (5)
Communications (VHF radio, fiber optic, and satellite)	$56.2 million	$60.7 million	$88.4 million
Construction – Total	**$672.4 million**	**$721.0 million**	**$1.28 billion**
Closure and reclamation	$77.7 million	$83.9 million	$122.2 million
Construction plus reclamation – Total	**$750.1 million**	**$804.9 million**	**$1.41 billion**
Costs* of annual maintenance:			
Road	$8.5 million/year	$9.3 million/year	$13.5 million/year
Maintenance stations (landing strips not separated)	$2.6 million/year (4)	$2.6 million/year (4)	$3.9 million/year (5)
Communications	$0.76 million/year	$0.82 million/year	$1.19 million/year
Total	$11.9 million/year	$12.7 million/year	$18.5 million/year

Source: DOWL 2016, 2019a, 2019b, 2023; USACE 2020; Analysis by the Bureau of Land Management (BLM)

Note: MP = Milepost

*Costs in the 2020 Final EIS are based on inflation/cost escalation through 2018 year-end data. Costs for the 2023 Supplemental Draft EIS were estimated by escalating the 2020 Final EIS values by using annual inflation/escalation values from four data sets: State of Alaska Department of Labor and Workforce Development Consumer Price Index (CPI) Urban Alaska values from end of 2018 through half 1 of 2023, State of Alaska Department of Labor and Workforce Development CPI U.S. City Average values from end of 2018 through half 1 of 2023, Federal Highway Administration National Highway Construction Cost Index (NHCCI) from end of 2018 through end of 2022, and Bureau of Reclamation Construction Cost Trends (CCT) for Secondary Roads from quarter 3 of 2018 through quarter 2 of 2023. These data sets and methodologies are consistent with data set and methodologies used by DOWL in updating cost estimates for the "Summary Report Addendum" and "SF299 Application: Communications Amendment" as provided to BLM in April 2019.

1.5. Summary of Impacts*

1.5.1 Approach to Summarizing Impacts of the Alternatives

The analysis presented in Chapter 3, Affected Environment and Environmental Consequences, documents the affected environment and the anticipated impacts of Alternatives A, B, and C, and compares those impacts to the No Action Alternative. Appendix C, Table 2 summarizes the impacts for each alternative. This section describes and compares the effects of the alternatives in narrative form, focusing on those key issues identified during public and agency scoping, and in internal discussions at the BLM and with cooperating agencies.

The subsections below present impacts associated with the summary in Appendix C, Table 2, and provide indication of the anticipated impacts' likelihood of occurrence, magnitude, duration, and geographic extent based on impacts discussions in Chapter 3. The definitions of the terms used are as follows:

Likelihood: Chapter 3 often addresses the likelihood of impact occurring by indicating the impact "would" occur or "could"/"may" occur. In this summary, likelihood is expressed as follows:

- High: impact would occur or risk of occurrence is high
- Medium: impact may or may not occur
- Low: impact unlikely to occur

Magnitude: The magnitude of impact is based on context for each resource described in the Affected Environment sections of Chapter 3 and the effect to the resource described in the Environmental Consequences sections of Chapter 3. Where impacts are quantified, magnitude is indicated in part by the quantities presented in Appendix C, Table 2 and in multiple tables associated with Chapter 3. (These tables appear in Appendices D [Chapter 3 Physical Environment Tables and Supplemental Information], E [Chapter 3 Biological Resources Tables and Supplemental Information], and F [Chapter 3 Social Systems Tables and Supplemental Information]).

Magnitude is related to the size of adverse or beneficial effect. An adverse effect is one that inflicts harm so as to impair value, usefulness, or normal function. Benefits are the opposite—an effect that improves a condition, adds value and usefulness, or enhances normal function. For the Physical Resources topics, this typically would mean depleting a resource naturally available. If a resource were already impaired, benefits would be to repair to a more natural state. Air quality, water quality, hazardous waste, and acoustic environment issues typically overlap with biological and social issues, and thresholds are related to biological health or human aesthetics. For Biological Resources, damage or improvement typically is based on populations, not just individuals of a species. For Social Systems, damage or improvement is based on effects to people, typically as groups or communities more than individuals, and to cultural practices. Magnitude in the subsections below is expressed as:

- Large: Considering the affected environment described for the resource, the project would damage or improve the resource. For biological and social topics, very large numbers of individuals or whole populations/groups/communities would be affected.
- Medium: Considering the affected environment described for the resource, the project would create measurable changes but not impacts clearly damaging (or clearly beneficial) to the resource. For biological and social topics, individuals or whole populations/groups/communities may be affected, but the effect would fall between Large and Small.

- Small: Considering the affected environment described for the resource, the project would create negligible change, with little or no damage or improvement to the resource. For biological and social topics, a few individuals within a population may be affected but populations/groups/communities would not be affected or would be minimally affected.

Duration: The duration of impact in Chapter 3 is often expressed in terms of temporary impacts of construction (a few years), or long-term impacts of road operation (most of the 50-year term of the proposed ROW grant), or longer, which is effectively permanent. Duration is abbreviated in this summary as follows.

- Permanent: beyond the 50-year term of the road ROW
- Long: for most or all of the 50-year term of the road ROW
- Moderate: intermediate duration
- Short: temporary—during construction or reclamation, or similar limited time, or 1-time effects

Extent: Extent of impacts often is expressed in maps associated with the various resources. More than 30 maps in Volume 4 help to show the extent of impacts, and other maps appear in Appendix H and in the technical reports in other appendices, such as the Subsistence Technical Report (see Appendix L). The extent of impacts is summarized in the subsections below as follows:

- Expansive: the project area mapped and described in the Draft Supplemental EIS as well as areas beyond, such as the ranges of caribou migration or subsistence hunting
- Large: covering large parts of the project area
- Medium: limited to 1 or more distinct parts of the project area not necessarily associated with the road corridor
- Small/Narrow: limited to little more than the road ROW/authorized use areas
- Minor: site-specific or limited to small portions of the authorized use area

The closest definition that appeared to apply was used, based on the best professional judgment of the Draft Supplemental EIS preparers. Note that most impacts discussed are considered adverse impacts, but beneficial impacts are anticipated also. The same terms are meant to apply to beneficial effects as to adverse effects. As this is a summary, reviewers are encouraged to read the body of this Draft Supplemental EIS and supporting appendices for additional context and detail.

In the following subsections, material provided by the USACE as a cooperating federal agency is included where it best fit the organizational structure of this document. The USACE material is from preliminary considerations regarding a required USACE finding of which alternative may be the least environmentally damaging practicable alternative (LEDPA).

1.5.2 Overall Considerations*

In general, Alternatives A and B share an alignment across the project area except at GAAR. Alternative B is 17 miles longer than Alternative A. Alternative C follows an almost entirely separate alignment, crossing different terrain and running approximately 50 percent longer (332 miles) than the other alternatives. While the driving distance to Fairbanks would be similar, the longer road construction length means correspondingly greater acreage of impacts to vegetation, wetlands, and wildlife habitat; greater impacts to streams; and greater uses of various tracts of (almost exclusively) public or Native corporation lands. Alternative C also would have greater effects on the Ray Mountains Herd (RMH) of caribou and on moose as well as greater involvement with discontinuous permafrost. Alternatives A and B would have

greater effects related to sheefish habitat, the WAH, and use of material containing NOA. Alternative A would cross the National Preserve (NPS-managed lands) for 26 miles. Alternative B would cross the National Preserve for 18 miles. Alternative C would not cross the National Preserve. Multiple commenters have noted that, whether park land, multiple-use federal or state land, or Native corporation land, the area as a whole is minimally developed and has value as a large, intact portion of arctic/subarctic wildlife habitat, subsistence-use area, and tourist attraction. This value would be reduced if divided by the presence of a road. In general, the road would be the first road into this area, regardless of alternative, and many impacts would have a larger incremental effect than similar impacts in an area that already had roads. Besides direct fill in wetland and upland vegetation habitats due to road construction, vegetation and animals near the road would be affected by road dust, noise, movement of vehicles, light or shading (at culverts and bridges), and potential spills of pollutants from truck traffic.

Across all of the action alternatives, the combined phasing option would generally reduce potential impacts to permafrost, water quality, and fish and would reduce the duration of noise and disturbance impacts from construction activities as compared to the 3 phase options. However, some short-term resource effects would be greater under the combined phasing option due to the wider footprint of the road during the combined Phase 1-Phase 2 effort.

1.5.3 Geology and Minerals*

The following summarizes Section 3.2.1. Construction could hasten thawing of permafrost in localized areas and could damage natural topography, alter water quality and flows, and vegetation patterns. This is somewhat more likely under Alternative C than under Alternatives A or B, because Alternative C crosses more discontinuous permafrost where the temperature of the permafrost is already closer to the thaw point.

A combined phasing option has the potential to reduce the impacts to soil and permafrost resources by limiting the potential impacts to permafrost and soil to a single phase of construction over fewer years with less temporary construction staging and access, which would cause fewer impacts to sensitive soils.

All action alternatives cross areas of NOA and rock that can generate acidic runoff when disturbed, although Alternative C crosses less area of known high NOA potential. Either can be harmful to the environment and human health. AIDEA has committed to avoiding the use of materials with NOA to the greatest extent feasible and to following State guidance for use of gravels containing NOA in construction projects if unavoidable (see Section 2.4.4, Design Features Proposed by AIDEA).

The project area is more subject to NOA than many other areas. The project footprint for Alternative A would have less area with known potential for NOA compared to Alternative B (396 acres versus 733 acres; see Table 2 in Appendix C). Alternative C would have substantially more area in the project footprint with known potential for NOA compared to Alternative A or B but no potential in the high category.

Under any alternative, a road would induce the development of valuable minerals at the District for delivery to market. Removal of valuable minerals would be a likely, large-magnitude, permanent impact in an area of medium extent.

Regarding asbestos, design commitments and mitigation measures to avoid cuts for road construction, to avoid the use of NOA-containing gravel materials, to require the capping of surfaces with non-NOA-containing materials, and to implement an enforceable dust control plan should minimize NOA-content within the road surface and road dusts. Airborne minerals with NOA would present greater risk of prolonged asbestos exposure to construction workers and vehicle drivers using the road. Overall, NOA

would likely be a medium-magnitude, long-term impact over a small/narrow area. Since small asbestos fibers may remain suspended in air for long periods of time and carried long distances by wind or water before settling, for residents of project area communities may experience small-magnitude, long-term NOA impacts over a medium area. Regarding permafrost, construction would exacerbate thawing of permafrost. The effects of the road would be likely, medium-magnitude, permanent impacts in minor areas.

1.5.4 Sand and Gravel Resources*

The following summarizes Section 3.2.2. Project construction and maintenance would use millions of cubic yards of construction-grade gravel and rock, requiring disturbance at more than 40 sites under any alternative. Additional material would be used annually for road maintenance. Alternative B would marginally have more material sites encompassing a larger area than the other alternatives. However, Alternative C would require substantially more gravel resources because it is a longer alternative. It has a similar number of identified material sites as the other alternatives, meaning each would be larger or deeper. The use of these resources would be a high-likelihood, medium-magnitude, long-term impact over a minor area.

The impacts from the combined phasing option would have the same effects as the other alternatives.

1.5.5 Hazardous Waste*

The following summarizes Section 3.2.3. Road construction and operations would include fuel handling. As a mining access road, road use would include transport of chemicals used in mining, liquefied natural gas, the mined ore, and other toxic materials. Toxic spills and dust are likely to occur at a small scale under any action alternative. Large spills or releases (e.g., truck rollover) could occur and damage adjacent waterways and habitat.

The potential range of accidents involving trucks carrying ore concentrate for the life of the project would be approximately 5.2 to 136.9 (2.4 to 64 for the new roadway and 2.8 to 72.9 for the Dalton Highway) annually for Alternative A, The potential range of accidents for Alternative B would be approximately 5.4 to 142.1 (2.6 to 69 for the new roadway and 2.8 to 72.9 for the Dalton Highway) annually. The potential range of accidents for Alternative C would be approximately 5.4 to 143.0 (3.8 to 101 for the new roadway and 1.6 to 42.2 for the Dalton Highway) annually. Construction of the combined phasing option would result in a shorter construction time for all action alternatives which may result in fewer incidences of construction-related leaks and spills of hazardous materials.

Alternatives A and B would be shorter new gravel roads than Alternative C, and thus, would generate less dust and less runoff from the new road and would have 3 maintenance stations versus 5 (sources of solid and human waste and potential sources of spills and leaks). A portion of the total driving distance to Fairbanks would be on the Dalton Highway (Alternatives A and B would use more than Alternative C), which is an established and maintained road. However, the total driving distance from the District to Fairbanks would be substantially similar for all action alternatives, so based on miles traveled, the risk of spills from traffic would be barely distinguishable. Large releases that could have large impacts to vegetation, fish, birds, mammals, and people would be low-likelihood impacts with generally medium duration, large magnitude, and medium extent. Small releases would be expected to occur despite best practices during fuel transport and handling and would be high-likelihood, short-or medium-duration impacts with small magnitude and typically minor extent. A toxic release of a relatively small amount of substance could lead to a larger impact if it occurred directly into flowing water and before a response could be mounted.

1.5.6 Paleontological Resources*

The following summarizes Section 3.2.4. While little work has been done to inventory paleontological materials on BLM-managed lands in the Central Yukon, many fossils have still been found in the area by placer miners, along drainages, or in other disturbed areas. These fossils span the Paleozoic Era (approximately 540 to 250 million years ago) to the Cenozoic Era (approximately 65 million years ago to present) and vertebrate, invertebrate, and plant fossils are all represented in the project area. Additionally, significant fossils of extinct large mammals characteristic of the Mammoth Steppe fauna from the late Pleistocene or ice-age time period have also been found in the Central Yukon. The Potential Fossil Yield Classification (PFYC) system is used to assess potential occurrences of paleontological resources in mapped geologic units. All alternatives contain only PFYC 1 and 2 areas, or areas with very low or low likelihood of containing fossils. Alternative C also passes through areas classified as PFYC U, or unknown. PFYC U areas could include significant paleontological resources, but the area is poorly studied; these areas are considered to have medium to high potential to contain paleontological resources until further studies are completed. Due to this classification, Alternative C has the highest likelihood of impacts to fossil resources, especially as it contains the largest acreage of disturbance.

The combined phasing option would have the same impacts to paleontological resources as the non-combined phasing options as the area of disturbance would be the same. These impacts could be direct, including damage or destruction of fossils, disturbance of the stratigraphic context of the fossils, and increased erosion and weathering of fossil-bearing units due to removal of ground cover. Indirect impacts could include increased unauthorized fossil removal or looting due to increased access to areas with paleontological resources. However, it is unlikely that paleontological resources would be found in the project area due to the low PFYC classification.

1.5.7 Water Resources*

The following summarizes Section 3.2.5. Ice road, bridge, and culvert construction; gravel extraction; gravel placement; water withdrawal; and wastewater discharge would affect water bodies. Water quality and water flows would be altered along the corridor compared to current, mostly natural conditions. Culverts would provide for primary flows beneath the roadway embankment but would have impacts to the natural hydrology. Dispersed overland flow would be concentrated into distinct flow channels leading to the culverts. Changes in water depth and velocity could result in changes in erosion or sedimentation, ponding, or channel migration. BMPs and other measures would be stipulated to minimize impacts (see Section 2.4.4, Design Features Proposed by AIDEA, and Appendix N), but these would not eliminate impacts.

Effects would be similar across alternatives, but Alternative C would cross more streams and fill more than double the floodplain area. Based on stream crossings requiring moderate and larger culverts or bridges, Alternative B would cross the fewest streams (55) and overall would be similar to Alternative A (68) and far fewer than Alternative C (523). Minor culverts, which would be used to cross small streams and for hydraulic connection in wetland areas, would number 2,864 for Alternative A; 3,150 for Alternative B; and 4,076 for Alternative C. See Appendix C, Table 1. Alternative A would cross fewer miles of floodplain (4.6 miles) compared to Alternative B (5.4 miles) and Alternative C (53.6 miles). The impacts to water resources would be high-likelihood, long-term (sometimes permanent) impacts of medium magnitude and small/narrow extent.

The combined phasing option has potential to reduce impacts to permafrost and water quality by limiting construction activities to a single construction phase. However, the combined phasing option may also result in more potential impacts from ice roads and ice pads due to a longer reliance on winter construction access trails relative to the phased construction options. In addition, the combined phasing

option may result in a greater need to stage equipment and stockpile materials at bridge crossings so that construction can continue following seasonal closure of the winter construction, which in turn may result in more temporary disturbances near river and stream crossings.

1.5.8 Acoustical Environment*

The following summarizes Section 3.2.6. Road construction and operation would create new sounds from vehicles, aircraft, and generators at maintenance stations and communications sites and from traffic along the length of the road. Except for some aircraft, summer boat traffic on larger rivers, and winter snowmobile traffic in a few areas, the project area has principally natural sounds. Longer alternatives (C) would create new sounds in more new places. Alternatives A and B would cross GAAR and the Kobuk Wild and Scenic River (as allowed in ANILCA 201(4)(b)) and would run near the designated Wilderness boundary, all managed for natural soundscape. Alternative A would impact a larger area within GAAR and would be located closer to the designated Wilderness boundary than Alternative B. Alternative C would avoid these sensitive areas. The indirect effects of induced mining also would create new industrial sound in a mostly natural soundscape. Acoustic changes related to the road project would be high-likelihood, long-duration, medium-magnitude impacts over a small/narrow area, except that aircraft would affect a somewhat larger area. Alternatives A and B impacts would be large magnitude at GAAR because of the sensitivity of management and of the many users in that area. Mining noise would be similar but additional, covering an additional area (see maps) and likely including construction-type sound levels for a longer duration (decades).

The combined phasing option would reduce the duration of construction-related noise effects under all action alternatives by approximately 1 to 2 years relative to the phased alternatives (up to 4 years total for Phases 1 and 2).

1.5.9 Air Quality and Climate*

The following summarizes Section 3.2.7. Air quality would be altered along the corridor compared to current, mostly natural conditions. No alternative would be expected to generate emissions of air pollutants, including dust, at levels that would approach or exceed national or Alaska ambient air quality standards (see Section 3.2.7), although quantitative modeling was not performed. However, all alternatives would result in emissions due to combustion for operating vehicles (see multiple tables in Appendix D), heating maintenance camps and buildings, and generating power at maintenance camps and for communications facilities. All would generate dust; asbestos and other toxins could occur in dust and be hazardous to those people commonly on the road. Emissions include those known to be harmful to human health in sufficient concentration and to contribute to climate change (see Section 3.2.7). Construction emissions for Alternative C would be nearly 50 percent larger than Alternative A, commensurate with the longer length of construction, and during road operations it would produce more dust overall, because the portion of mining-related traffic on the gravel Ambler Road would be longest. However, for emissions associated with transport of ore from mines to port by truck and rail, Alternative C would result in somewhat less overall tonnage of greenhouse gas (GHG) emissions than Alternatives A or B; although, the differences are not large (see Section 3.2.7). Alternative C also would avoid GAAR, which is managed to maintain natural air quality, while Alternatives A and B would not. See Appendix C, Table 2 and multiple tables in Appendix D.

The combined phasing option would reduce the duration of construction under all alternatives relative to the phased option. As a result, the amount of construction-related emissions and fugitive dust may be slightly reduced, depending on the type and quantity of construction equipment that is used. However, if the combined phasing option uses a greater amount of equipment to compensate for the shorter duration is unknown and could affect air quality. Additionally, the combined phasing option has the potential to

reduce impacts to permafrost and sensitive soils by reducing temporary disturbance, which could reduce the potential for GHG emissions from permafrost thaw.

Changes to general air quality are expected to be high-likelihood, small-magnitude, long-duration impacts over a small/narrow area. The contribution of GHG emissions from the project to climate changes would be very small on a global scale. GHG emissions would be high-likelihood, small magnitude, long-term contributions to climate change effects of expansive (global) extent. Changes particularly to visible air quality due to dust would be of medium or greater magnitude where visible in and near GAAR because the area is managed for natural air quality and visual aesthetics and the sensitivity of users in this area.

1.5.10 Vegetation and Wetlands*

The following summarizes Section 3.3.1. All alternatives pass through areas with wetlands, and constructing a road would eliminate both upland and wetland vegetation. Appendix C, Table 2 presents multiple measures of impact of the road project on vegetation and wetlands. In general, the longer the alignment, the bigger the footprint and consequently the greater the loss of or effect on vegetation and wetlands and their functions, including habitat for wildlife, flood attenuation, and permafrost insulation. Alternative C typically would have effects of 50 percent or more than those of Alternative A. The effects of Alternative B would be intermediate but closer to Alternative A. Alternative A would have fewer temporary and indirect effects (fugitive dust impact) to wetlands compared to Alternatives B and C. Alternative A would pass within 0.25 mile up-gradient of a rare wetland, the Nutuvuki Fen, creating a risk of pollutants entering the fen. Alternative B would pass down-gradient, while Alternative C would be located far from the fen. Overall, losses and damage to wetlands and vegetation would be high-likelihood, small- to medium-magnitude impacts of long or permanent duration and covering a small/narrow area along the road corridor. See also Section 2.5.7, Water Resources.

The combined phasing option would not be expected to alter the impacts to vegetation, wetlands, or rare plants. In addition to the direct impacts described above, indirect impacts to wetlands and vegetation would be expected to occur outside of the 328-foot primary corridor of direct impact, mostly due to changes in hydrology and thermal regime caused by the road structure. Increased development and climate change would likely result in changes to natural wildfire regimes with cascading effects to plant communities. These changes would likely occur within several years of road construction.

1.5.11 Fish and Aquatics*

The following summarizes Section 3.3.2. The road would impact fish habitat and alter free fish passage based on likely changes to channels, flows, sedimentation, and other changes to the water resource caused by culverts, bridge piers, alteration of surface and subsurface flow patterns, and other effects. Non-point-source pollutants in runoff and from dust as well as spills or leaks of toxic material could affect fish health and could damage spawning and rearing habitat. There are few known sheefish spawning areas in Alaska, and two are in the project area. Alternatives A and B would cross multiple streams upstream of these spawning areas, with Alternative B closest at 7 miles upstream. Alternative C would cross downstream of these spawning areas. Salmon and sheefish spawning grounds could be affected by a toxic spill (see also Section 1.5.5, Hazardous Waste).

Potential impacts to fish and aquatic resources would stem from initial construction of a wider road requiring longer culverts and more water withdrawals for ice road/pad development. This could impact water quantity and quality and therefore impact fish and aquatic resources in the short term. However, long-term impacts to fish and aquatic resources would overall be reduced through the phasing process.

Changes from direct loss of habitat, such as the road or materials sites resulting in fill or excavation in wetlands used as fish rearing habitat, along with effects of road dust and general road runoff on adjacent water quality, would be high likelihood, large magnitude, long-duration impacts of a small/narrow extent.

Changes related to culverts and bridges that would channel sheet flow, impound water, change water velocities and erosion/sedimentation patterns, and possibly change the local relationship of ground water and surface water would affect fish movement and degrade the quality of habitat. These would be high-likelihood, large magnitude, long duration impacts of a minor to small extent.

Ice road segments and ice bridges can temporarily alter or block sheet flow and the natural distribution of surface waters during spring breakup, which could impact individual fish but is not likely to have an impact on fish populations. Ice road and ice pad meltwater could have temporary localized effects on water quality and water withdrawal for ice infrastructure can all alter fish habitat. These impacts would be temporary and short term and are not expected to have population level effects on resident and anadromous fish.

Particularly with mitigation in place, spills and leaks may be high likelihood and may be of short- to long-duration but would be small magnitude and of minor extent. While the likelihood is low, there is potential that direct activity associated with the road or indirect activity associated with the mines could result in toxic releases sufficient to eliminate or damage populations of fish downstream (see Section 3.3.2), with the Kobuk River drainage at greater risk than the Koyukuk drainage, because both the road and mines would occur in the Kobuk drainage. A catastrophic spill or discharge of toxic material directly into fish habitat would be a low-likelihood, large-magnitude impact of potentially long duration and medium extent.

1.5.12 Birds*

The following summarizes Section 3.3.3. The impacts from the road project on birds would include alteration of terrestrial and aquatic habitat, disturbance and displacement of birds, and injury or mortality. Vegetation removal and gravel fill replacement would result in loss of breeding, nesting, foraging, staging, and stopover habitat for birds. Noise and light pollution may also impact birds at farther distances than the project footprint, causing higher stress levels and inhibited predator detection and altering singing, nesting, and mating patterns. The types of potential effects would be similar for each alternative and would vary based on the available habitat types under each action alternative.

Alternatives A and B would have nearly identical impacts and somewhat more uniform habitat types. Associated with a substantially larger project footprint, Alternative C would affect more habitat than the other alternative. Along Alternative C, these would include areas noted for richness of waterfowl species and more alpine habitat areas than the other alternatives. Overall, changes to bird populations and bird habitat would be high-likelihood, small- or medium-magnitude, long-duration impacts over a small/narrow extent.

The combined phasing option would result in similar acreage of habitat lost as the phased alternatives, with similar impacts to birds. However, a thicker road embankment would mitigate impacts to permafrost, water quality, and aquatic habitats, which could reduce indirect impacts on bird species and habitat quality.

1.5.13 Mammals*

The following summarizes Section 3.3.4. The road project would fragment wildlife habitat. This has been of most concern among public and agency commenters for the WAH, which, during roughly 1985-2015,

migrated across the project area south and west from the western North Slope to the upper Kobuk and Selawik drainages, Nulato Hills and Seward Peninsula. Since about 2016, much of this herd has wintered on the North Slope, in the west-central Brooks Range west of the Dalton Highway, and in the upper Koyukuk and Kobuk drainages within and near the project area.. Appendix C, Table 2 reports acreages of different caribou habitats directly lost for the WAH and RMH; however, the values reported represent only the acreage covered by gravel or infrastructure and do not reflect the much larger areas of seasonal ranges where caribou distribution or movements could be impacted by the road and associated traffic, infrastructure and human activities. Only Alternative C would affect the much smaller and non-migratory RMH, as well as the WAH. Alternatives A and B would increase traffic along the Dalton Highway which could cause increasing fragmentation for the HHH. Alternative A would impact less WAH caribou habitat (4,161 acres) compared to Alternative B (4,775 acres). Alternative C would impact 4,120 acres of WAH habitat. For all alternatives, approximately half of the habitat loss would be from peripheral habitat. Alternative C would use approximate one-third the area of migratory habitat (419 acres) compared to Alternatives A (1,287) and B (1,347). The presence of a road and road noise could affect caribou migration patterns and movements of other animals. Changes in migration could alter where caribou spend their winters and their routes of travel between summer and winter ranges; affect energy expenditure of the animals; and, with other pressure from other developments and climate change, could affect calving and survival rates (see Section 3.3.4) as well as herd availability to subsistence communities AIDEA has committed to implementing measures that would require drivers to stop and wait when caribou were on or near the road, and to report caribou movements (Section 2.4.4, Design Features Proposed by AIDEA). Alternative C would affect more area moose habitat than the A/B alignment. The road project also would be expected to result in vehicle-animal collisions, changes to predation patterns, and other disturbance and displacement for most mammals using habitat the road would pass through. Additionally, some trespass by hunters may occur on the road and increase harvest of animals in the area. Additionally, based on experience with the Dalton Highway and DMTS where public access was granted to a previously closed road, the Ambler Road eventually may be opened to the public for hunting, fishing and other uses. If open to the public, federal and state agencies may need to adjust hunting regulations to prevent overharvest of wildlife, which in turn could impact subsistence users with more complex and restrictive regulations.

Under the combined phasing option, caribou would have less opportunity to be exposed to a small pioneer road and potentially increase their tolerance to the larger Phase 2 road as both phases would be completed at the same time. Impacts from roads mentioned above would still be expected under the combined phasing option, with potential for fewer impacts depending on the timing and season of construction activities.

Overall, changes to mammals and their habitat would be high-likelihood, medium-magnitude, long-duration impacts, mostly in an area of small or medium extent but for migrating caribou could affect an expansive area beyond the specific project area. Changes in availability of caribou to subsistence users could be a high-magnitude impact for impacted communities. See also Section 3.3.4. Population-level effects to caribou are less likely but could be large-magnitude effects and impact all subsistence harvesters throughout the annual range of the herd. There are many unknowns about most mammals other than caribou in the project area; uncertainty means impacts could be lower or higher.

1.5.14 Land Use/Land Management*

The following summarizes Section 3.4.1. All alternatives would principally cross public lands of the state and federal governments, and also Native corporation lands (Doyon and NANA corporations). Appendix C, Table 2 presents acreages by land owner. Alternatives A and B would affect a much higher proportion of State land than Alternative C, which would affect more than 5 times the acreage of federal land. All

alternatives would cross many hundreds of acres of Native corporation lands, with Alternative C using nearly 50 percent more Native corporation lands than Alternatives A or B.

Congress established GAAR explicitly allowing for a road to the District. GAAR is a specially designated unit of federal public land managed generally for conservation purposes. GAAR is managed to protect its wild and undeveloped character and to provide continued opportunities for subsistence activities. No alternatives would enter GAAR's congressionally designated wilderness. Alternatives A and B would cross the National Preserve and the Congressionally designated Kobuk Wild and Scenic River as allowed by Congress in ANILCA, and Alternative A would parallel the wilderness boundary close enough to be seen from higher elevations of the wilderness area. Alternative A would run 27 miles within the Preserve and would be approximately 0.5 to 3 miles south of the wilderness area. Alternative A would be approximately 0.25 mile north of Nutuvukti Lake and would largely avoid Walker Lake, which is located approximately 4 miles to the north of the proposed road. Alternative A would cross the Kobuk Wild and Scenic River. Nutuvukti and Walker lakes are popular fly-in locations in the park, with Walker Lake the primary start location for float trips down the Kobuk River, but visitation is light (see Section 3.4.3, Recreation). Alternative B would run 17 miles in the Preserve, would be 6 miles or more south of the wilderness boundary, and would cross the Kobuk Wild and Scenic River farther downstream. Alternative B would have minimal or no impact to the viewshed or sounds in the Nutuvukti and Walker lakes areas. Alternative C would avoid GAAR entirely and would be more than 30 miles from the wilderness boundary. Under ANILCA 201(4), Congress stipulated (1) the U.S. Department of the Interior "shall permit...access" for surface transportation to the Ambler Mining District across the Preserve and (2) the Preserve "shall be managed…to maintain the wild and undeveloped character of the area, including opportunities for…solitude." While such a road would be intended under number 1, it would be developed under number 2. Alternative A would have the greatest overall impact to visitor experience in the park and wilderness values largely because of viewshed and noise impacts at Nutuvukti Lake, the wilderness boundary, and to a lesser extent at Walker Lake.

The combined phasing option would not result in differential impacts than Alternatives A, B, or C as the ROW and road width would not be expected to change.

The NPS has the primary responsibility for requiring measures that would result in a reduction of impacts to noise and viewsheds in the Preserve. Examples of possible minimization measures are reduced truck speeds and vegetation buffer plantings in select areas.

Overall, the project would separate out certain land-use rights and assign them to AIDEA for the 50-year term of the ROW. This would alter land management under those rights in the narrow ROW. Under any alternative, the overall effects to land ownership would be minimal; underlying ownership would remain and all land rights would revert to the underlying owner at the time of road closure. Changes to management mostly would be high-likelihood, small-magnitude, long-duration impacts over a small/narrow area.

1.5.15 Transportation and Access*

The following summarizes Section 3.4.2. The alternatives would be 211 (Alternative A), 228 (Alternative B), and 332 (Alternative C) miles long. Under any alternative, the project would create a new transportation facility in an area without existing road access. While this would substantially change the ability to travel by vehicle in the project area, the road would be an industrial mining road and not an addition to the system of public roads. The project also would result in 3 (Alternatives A and B) or 5 (Alternative C) new airstrips. These would be for AIDEA's use only and would not provide for new general public access via air. The road and airstrips would be closed and removed at the end of the ROW authorization. Appendix C, Table 2 reports the total driving distance to Fairbanks, which is very similar

among the alternatives, and total transport distance to a port, assuming the Port of Alaska in Anchorage as the destination. Appendix C, Table 2 also reports anticipated mining-related average daily traffic, which would be identical across the action alternatives. Alternatives A and B would increase traffic by up to 238 trips per day on 161 miles of the Dalton Highway. Alternative C would equally increase traffic, but on 59 miles of the Dalton Highway.

Construction and use of an ice road/ice pads would be expected in increase traffic on the Dalton, Elliott, and Steese highways during the winter months between the Ambler Road and Fairbanks. The reduced construction duration of the combined phasing option would result in increased average construction traffic, impacting road and rail routes beyond Fairbanks.

Connection of communities to the Ambler Road is predicted to occur at Kobuk under all alternatives and is considered reasonably foreseeable by road, year-round trail, or winter trail at Shungnak, Ambler, Bettles, and Evansville under Alternatives A and B, and at Shungnak, Ambler, and Hughes under Alternative C. This would allow any community that decided to connect to transport goods and fuel via commercial transporter at lower costs than air transport. The spur roads may be open to the public, but the Ambler Road would be open only for permitted commercial transporters. Changes to transportation would be high-likelihood, medium-magnitude, long-duration effects over an expansive area,

1.5.16 Recreation and Tourism*

The following summarizes Section 3.4.3. Recreation and tourism are closely related to wilderness characteristics in the area. Opportunities for solitude would be affected whether backpacking, rafting, fishing, or hunting by floatplane or motorboat, or going to traditional fish camps from nearby communities. Tourism could be affected by a change in the reputation of the area from road-free to having a road, but the overall rate of tourism is not expected to drop as a result of the road. Many recreational trips begin in GAAR and involve floating out of the Brooks Range to downstream communities or places where aircraft can get in to fly people out. Visitors would pass under Alternative A and B bridges midway through their multi-day trips, often trips that started on a designated wild and scenic river (designations end where the rivers flow out of GAAR). Visual and noise impacts would affect the experience. See also Section 2.5.14 (Land Use/Land Management) regarding GAAR management. The Ambler Road itself is not expected to generate new recreation and tourism opportunities or access because it would not be open to the general public or tour operators. Two existing fly-in lodges that market their remote locations would be near the Alternative A and B alignments, and the visitor experience could be affected. However, the lodges and communities may have potential for commercial delivery of materials and supplies by road, likely for transfer by snowmobile or boat to their end destinations. Alternative C would traverse less sensitive recreational areas but over a longer distance and would affect more rivers that see motorized boat transportation for all purposes, including recreational fishing, hunting, and camping.

The impacts of construction under the combined phasing option would be more short-lived and limited in scope due to the shorter duration of construction. The expedited timeline would require winter construction and greater reliance on winter access trails and have impacts for winter cross-country recreational travel.

Dalton Highway recreation and tour traffic and facilities (e.g., waysides) would experience a substantial increase in truck traffic during peak years of mining district development, and Alternatives A and B would affect 100 miles more of the Dalton Highway than Alternative C. Overall, changes to recreation and tourism experiences would be high-likelihood, medium-magnitude, long-duration impacts over an area of large extent.

1.5.17 Visual Resources*

The following summarizes Section 3.4.4. The visual environment would be substantially changed from principally undeveloped forest, tundra, mountains, and rivers to an industrial corridor with contrasting lines, forms, colors, textures, and lights. The road would be readily apparent from the air, higher elevation vantage points, and in foreground views when approached. Much of the area has had a visual inventory by the BLM, and Alternative B would cross the most Class II lands (the most visually valuable in the area), at 107 miles. Alternatives A and C would cross 107 and 76 miles, respectively. This does not include GAAR lands.

The combined phasing option would result in more visual impacts due to increased construction, but the impacts would be shorter lived.

Overall, the project area is sparsely inhabited and not heavily traveled, so no mass of viewers would be affected, and only GAAR is managed specifically to preserve a natural visual environment (the road also is allowed in GAAR under ANILCA). However, those people who do use the area are likely to be sensitive to visual changes, particular on river floating corridors and within GAAR. Therefore, while Alternative C would affect a larger area, the visual effects may be greater for Alternatives A and B, and particularly for Alternative A, which runs within an area that would be visible from vantage points within Congressionally designated wilderness. Overall, visual changes would be high-likelihood, large magnitude, long-duration impacts over a small to medium extent.

1.5.18 Socioeconomics and Communities*

The following summarizes Section 3.4.5. Social impacts, including those to subsistence and communities, would be of the same type for all action alternatives. However, different communities would be affected depending on the alternative. All action alternatives would affect Kobuk, Shungnak, and Ambler, with direct road connection to Kobuk anticipated to develop and changes related to less expensive delivery of fuel, groceries, and construction materials likely. Alternatives A and B would be more likely to affect Bettles and Evansville, while Alternative C would be more likely to affect Hughes (with a future road or year-round trail connection anticipated to develop from Hughes to the proposed Ambler Road). Alatna and Allakaket lie between the Alternative A/B and Alternative C alignment and likely would be affected by any action alternative, but to lesser degrees than closer communities. Communities could benefit from road construction and maintenance jobs, and ultimately from new mining jobs. Because of its longer length and higher cost, Alternative C would generate more construction, operations, and maintenance jobs. Appendix C, Table 2, summarizes jobs, and detail is provided in tables in Appendix E. The cash income from jobs would help individuals and community economies, and could encourage people to move back or stay in the region due to employment opportunities, but also could result in migration to urban areas.

Under the combined phasing option, the number of workers required per year during construction would likely be higher, potentially doubling. The employment effects during the operations and maintenance phases would be the same as the non-combined phasing options. For communities connected to the Amber Road infrastructure, public health could be affected in communities closest to the road both by (1) emergency medical access via road and enhanced medical internet access (telemedicine), and (2) easier access to non-traditional foods and other more-easily imported items that negatively affect health. See also Public Health in Section 3.4.5. Statewide and regional economic benefits from jobs and payments to governments and Native corporations would be high-likelihood, large-magnitude, long-duration impacts over an expansive extent. Adverse social changes would be high-likelihood, variable-magnitude, long- or permanent-duration impacts mostly in the few closest communities (minor extent). See also Section 2.5.20, Subsistence.

1.5.19 Environmental Justice*

Environmental justice has to do with "disproportionately high and adverse effects" to low-income and minority populations. See Section 3.4.6. Low-income and minority populations make up most of the populations of project-area communities. Impacts to subsistence and public health, including stress, subsistence-food insecurity, and potential exposure to toxins from road and mine operations would disproportionately affect low-income and minority populations, specifically Alaska Native villages in and near the project area that depend on the surrounding area for their subsistence lifestyle. Impacts to employment would occur but would not be expected to disproportionately benefit low-income and minority populations. Where adverse impacts to residents are discussed throughout the EIS, these impact would fall disproportionately on minority and low-income populations. The effects of the alternatives would be similar.

The combined phasing option would not be expected to differentially impact EJ communities when compared to Alternatives, A, B, and C. All would affect Kobuk, Shungnak, and Ambler as communities nearest the road terminus and mines. In addition, Alternatives A and B would affect Evansville, while Alternative C would affect Hughes. All disproportionately high and adverse effects to minority or low-income populations would be long to permanent in duration. See also Section 2.5.18, Socioeconomics and Communities, Section 2.5.20, Subsistence, and Section 2.5.21 Cultural Resources).

1.5.20 Subsistence*

The following summarizes Section 3.4.7., Subsistence, an important underpinning of Alaska Native culture, lifestyle, and economy that would be affected by the project. There are 27 communities with subsistence use areas that overlap the alternatives; 32 communities who harvest fish downstream from the alternatives; and 42 communities who harvest from the WAH caribou herd which migrates through the project area. Subsistence use would be altered by the presence of a road, both because a road would affect wildlife behavior and distribution and because it would bisect travel routes used by hunters and affect their access to subsistence use areas. Seven subsistence communities would have 5 or more of their subsistence use areas directly affected by the road under Alternatives A and C; 8 communities would be affected at this level under Alternative B (Table 2). Kobuk, Shungnak, and Ambler would be similarly affected under all action alternatives. Alternative A would also affect Bettles, Coldfoot, Evansville, and Wiseman; Alternative B would also affect Alatna, Bettles, Coldfoot, Evansville, and Wiseman; and Alternative C would also affect Alatna, Allakaket, Hughes, and Stevens Village. Under all alternatives, other communities also would be affected but with fewer subsistence areas involved or indirectly. The road and mines could cause individual and community impacts related to collection of traditional foods. See also Section 2.5.18, Socioeconomics and Communities. The alternatives would run close to Native allotments, which are often bases for subsistence activities, in addition to traditional fish camps and hunting camps. The road corridor could affect use of and access to these allotments and camps. Alternative C would run past several allotments near Kobuk and scattered others near Hughes and in the Ray Mountains. Alternative B would pass a block of 3 allotments at Narutuk Lake, and Alternatives A and B would pass 2 allotments at Avaraat Lake and others at greater distance (see Section 3.4.1, Land Use, and Section 3.4.7, Subsistence). Alternatives A and B cross through key migratory range for the WAH and drainages that contain spawning grounds for sheefish and salmon, and could therefore affect resource availability for caribou and fish study communities. Alternative C does not cross through the primary migratory range for the WAH, but does occur within the WAH wintering grounds. Therefore, this alternative has a lower potential for changes in resource availability resulting from impacts on fall migration but could affect winter distribution or survival. In all cases, increased traffic along the Dalton Highway could affect resource availability of the HHH for communities who harvest from this herd. Alternative C would have less direct impact on sheefish spawning grounds but crosses salmon spawning streams upstream from Yukon River fish study communities. Long-term impacts to subsistence users and

resources would be reduced under the combined phasing option, but short-term impacts to resources such as fish would be increased due to higher water withdrawals for ice roads and ice pads under this option.

Overall, changes to subsistence uses would be high-likelihood, high-magnitude, long- or permanent-duration impacts over an expansive area for all alternatives. The magnitude of impacts is high overall, because the project could impair subsistence for multiple communities whose subsistence use areas are bisected or partially bisected by the project. In addition, impacts could extend beyond those directly affected communities to other communities as a result of disruption of intercommunity sharing networks or changes in the availability of caribou or fish, particularly for the 25 (caribou) and 24 (fish) study communities for whom these are resources of high importance (see Table 2). The magnitude of impact to subsistence access can be reasonably estimated and may be high for certain communities whose use areas are bisected or partially bisected by the road corridor; while commitments to provide for road crossings would help reduce access impacts, they would not eliminate those impacts or remove the potential for changes to communities' subsistence patterns. Impacts to subsistence access would be low to medium for communities whose use areas are on the periphery of the project or communities for whom there is no overlap. The magnitude of resource availability and abundance impacts to fish, caribou, and other food sources is not as clear because of uncertainties about the populations in the area and whether and how they would react to a road and whether or not substantial spills ever occurred; magnitude of impact to wildlife could be small, medium, or large; see also discussions of fish and mammals (see Section 2.5.11, Fish and Aquatics, and Section 2.5.13, Mammals1.5.13).

1.5.21 Cultural Resources*

The following summarizes Section 3.4.8. As indication of comparative potential effects, many more known cultural sites and historic trails are present within 1 mile of Alternative A than within that distance of the other action alternatives. Alternative A runs near 309 known cultural sites, compared to 148 for Alternative B and 62 for Alternative C. The difference could be because more cultural resource inventory work has been done near the Alternative A/B alignment. Due to the long history of land use in the area, there is a high likelihood that additional historic properties are located along all the alignments. (See Section 3.4.8 for more on these topics). A combined phasing would generally result in the same impacts as described above for each alternative. The reduction in construction time would reduce the duration for construction related noise impacts to culturally sensitive areas and resources and reduce potential impacts from construction workers.

Implementation of a PA (see Appendix J) for a selected alternative would ensure cultural resources were identified and potential effects to resources that were eligible to be listed in the National Register of Historic Places (NRHP) were mitigated. The Programmatic Agreement (PA) was developed through consultation with state and federal agencies, tribes, local governments, and other interested parties, and will be executed prior to the EIS Record of Decision (ROD). Overall, the expected changes to cultural resources, historic properties, and collective cultural knowledge would be high-likelihood, medium-magnitude, permanent effects over an area of minor extent.

Table 2 summarizes the impacts by resource category and resources affected for each alternative. Unless otherwise noted, impacts given are for the entire road project, including the road, airstrips, maintenance camps, material sites, and material/water access roads. For additional information, see Chapter 3 (Affected Environment and Environmental Consequences), appendices, and technical reports for each resource category.

Table 2. Summary of impacts for each alternative

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Geology and Soils	Permafrost, NOA, ARD.	Thawing of some permafrost likely based on current trends.	Road construction likely to exacerbate thawing of permafrost and resultant ground settlement in the road corridor. All alternatives cross areas of NOA, and asbestos dust is a health hazard. Disturbing soils has potential to generate ARD where sulfide minerals are exposed.	Similar to Alternative A.	Similar to Alternative A, with somewhat less known NOA.	Reduced impacts to permafrost through use of permafrost protective embankments and reducing duration of use of temporary access trails.
Geology and Soils	Indirect effects.	Unlikely to result in removal of minerals from the District to market.	Would lead to removal of minerals from the District to market.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A
Geology and Soils	Area underlain by continuous permafrost.	N/A	3,510 acres (78% of route)	3,738 acres (73% of route)	283 acres (3% of route)	Impacts are the same as described under each of the action alternatives.
Geology and Soils	Area underlain by discontinuous permafrost.	N/A	347 acres (8% of route)	447 acres (9% of route)	1,234 acres (15% of route)	Impacts are the same as described under each of the action alternatives.
Geology and Soils	Area underlain by moderately thick to thin permafrost	N/A	667 (15% of route)	953 (19% of route)	3,662 (45% of route)	Impacts are the same as described under each of the action alternatives.
Geology and Soils	Area (acres) of project footprint with known potential for NOA.	N/A	Known High: 88 acres Known Medium: 106 acres Known 0 to Low: 202 acres Unknown (unevaluated surface deposits): 4,120 acres Other (water): 8 acres	Known High: 168 acres Known Medium: 198 acres Known 0 to Low: 367 acres Unknown: 4,395 acres Other (water): 9 acres	Known High: 0 acres Known Medium: 1,279 acres Known 0 to Low: 2,267 acres Unknown: 4,645 acres Other (water): 20 acres	Impacts are the same as described under each of the action alternatives.
Sand and Gravel	Number of material sites and projected total acreage.	N/A	Estimated required borrow material for road construction would be 15 million cubic yards	Estimated required borrow material for road construction would be 16.8 million cubic yards	Estimated required borrow material for road construction would be 22 million cubic yards	Impacts are the same as described under each of the action alternatives.
Hazardous Waste	Risk of toxic releases to the environment.	N/A	Toxic spills and dust are likely to occur at a small scale under any action alternative. Large spills or releases from a truck rollover could occur and damage adjacent waterways and habitat. Potential range of accidents involving trucks carrying ore concentrate would be 2.4 – 64 annually.	Similar to Alternative A. Potential range of accidents involving trucks carrying ore concentrate would be 2.6 – 69 annually.	Similar to Alternative A. Alternative C is approximately 50% longer than Alternative A, so would have greater direct risk of spill from truck rollover on the new road, but overall driving distance to Fairbanks would be similar, so overall risk would be similar. Potential range of accidents involving trucks carrying ore concentrate would be 3.8 – 101 annually.	Reduced construction time would result in reduced use of chemicals, production of solid waste, or transport of these items associated with construction.
Paleontological Resources	Area of project footprint by PFYC (Classes 1–5; water and unknown areas not given).	N/A	Class 1–2 (very low/low): 4,524 acres Class 3–5 (moderate–very high): 0 acres Class U (Unknown): 0 acres	Class 1–2 (very low/low): 5,138 acres Class 3–5 (moderate–very high): 0 acres Class U (Unknown): 0 acres	Class 1–2 (very low/low): 7,785 acres Class 3–5 (moderate–very high): 0 acres Class U (Unknown): 406 acres	Impacts are the same as described under each of the action alternatives.
Paleontological Resources	Effects on fossil and non-fossil evidence of ancient life.	Weathering and erosion of resources would occur naturally.	Construction could affect fossil and non-fossil evidence of ancient life.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A
Water Resources	Effects to water resources.	N/A	Ice road, bridge, and culvert construction; gravel extraction; gravel placement; water withdrawal; and wastewater discharge would likely alter surface and subsurface flow patterns and water quality. The impacts of each alternative would be similar, with extent of impact governed largely buy the length of the alternative.	Similar to Alternative A, but slightly longer alignment means slightly greater impact.	Similar to Alternative A, but much longer alignment means correspondingly greater impact.	Impacts would be similar as described under each of the action alternatives except there may be increased temporary disturbances near river and stream crossings associated with staging materials.
Water Resources	Miles of alignment in floodplain (including bridge and culvert crossings).	N/A	11.6 miles	12.4 miles	77.7 miles	Impacts are the same as described under each of the action alternatives.
Water Resources	Miles of alignment located within 1,000 feet of floodplain.	N/A	16.1 miles (8%)	17.3 miles (8%)	96.3 miles (29%)	Impacts are the same as described under each of the action alternatives.
Water Resources	Area of assumed floodplain impact by bridges and culverts (includes multiple assumptions).	N/A	2,153 acres	2,133 acres	4,526 acres	Impacts are the same as described under each of the action alternatives.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Acoustical Environment	Direct effects to soundscape.	N/A	Road construction and operation would create new sounds from vehicles, aircraft, and generators at maintenance stations and communications sites. Longer alternatives would create new sounds in more new places. Alternative A would cross GAAR and the Kobuk Wild and Scenic River and would run near the designated Wilderness boundary, all managed for natural soundscape.	Similar to Alternative A. Alternative B would cross GAAR and the Kobuk Wild and Scenic River, both managed for natural soundscape. However, road noise generally would not extend to Wilderness.	Similar to Alternative A. However, Alternative C would not cross GAAR. It would pass near Kobuk and Hughes and could create noise impacts in and near these communities.	Reduced construction time would result in reduced duration of noise impacts for each alternative.
Acoustical Environment	Indirect and cumulative effects.	N/A	Mining in the District would be the same under all action alternatives and would create substantial industrial noise from continual blasting and earth moving with oversize vehicles, in addition to road and air traffic noise. Ambler Road noise combined with mine-related noise would create cumulative impacts over substantial parts of the District.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Air Quality and Climate	Emissions and effects on air quality.	N/A	Pollutants, including dust, would be emitted from construction and operation of the road under all action alternatives. The areas affected would differ by the location and length of each alignment. Effects mostly would be small and localized to the road corridor. No criteria pollutants would be expected to exceed thresholds established for human health. Alternative A would pass through GAAR, a sensitive air quality area.	Similar to Alternative A.	Similar to Alternative A, but Alternative C would not pass through any sensitive air quality area. As a much longer alternative, it would create new emissions in a larger area, but overall GHG emissions would be lower than Alternatives A and B.	Construction-related emissions and fugitive dust may be slightly reduced due to reduced construction duration. Reduced impacts to permafrost and thaw-sensitive soils would reduce the potential for GHG emissions from permafrost thawing under all action alternatives
Air Quality and Climate	Criteria pollutant operational emissions (tons/year) and GHG emissions from construction (tons) and operational ore transportation (tons/year)	NA	For District traffic, District to Fairbanks: Carbon monoxide: 13.7 tons/year Nitrous oxide: 39.3 tons/year Sulfur dioxide: 0.4 tons/year Volatile Organic Compounds: 2.7 tons/year PM_{10} (with dust control): 6530 tons/year $PM_{2.5}$ (with dust control): 681.7 tons/year Construction GHG (CO2e): 99,136 tons Operations GHG (CO2e): 54,230 tons/year	For District traffic, District to Fairbanks: Carbon monoxide: 14.1 tons/year Nitrous oxide: 40.5 tons/year Sulfur dioxide: 0.4 ton/year Volatile Organic Compounds: 2.8 tons/year PM_{10} (with dust control): 7,039.7 tons/year $PM_{2.5}$ (with dust control): 732.7 tons/year Construction GHG (CO2e): 111,020 tons Operations GHG (CO2e): 55,835 tons/year	For District traffic, District to Fairbanks: Carbon monoxide: 13.3 tons/year Nitrous oxide: 37.2 tons/year Sulfur dioxide: 0.4 ton/year Volatile Organic Compounds: 2.6 tons/year PM_{10} (with dust control): 10,070.8tons/year $PM_{2.5}$ (with dust control): 1,024.2 Construction GHG (CO2e): 154,395 tons Operations GHG (CO2e): 51,972 tons/year	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Vegetation impact, 10-foot construction zone.	N/A	611.5 acres	678.3 acres	927.3 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Vegetation impact/cut-fill in project footprint.	N/A	4,523.9 acres	5,137.9 acres	8,210.2 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Vegetation impact, primary dust zone.	N/A	17,895.8 acres	19,834.2 acres	26,092.3 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Wetland impact, 10-foot construction zone.	N/A	343.3 acres	396.3 acres	571.6 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Wetland impact/cut-fill in project footprint.	N/A	2,079.2 acres	2,415.8 acres	3,890.0 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Wetland impact, primary dust zone.	N/A	10,837.1 acres	12,269.9 acres	16,289.7 acres	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Percent of route going through wetlands and waterbodies.	N/A	56%	58%	62%	Impacts are the same as described under each of the action alternatives.
Vegetation and Wetlands	Rare/higher value wetlands (Palustrine Emergent and Nutuvuki Fen)	N/A	116.3 acres built in Palustrine Emergent. 0.25 mile up-gradient of Nutuvuki Fen.	118.6 acres built in Palustrine Emergent.	249.8 acres built in Palustrine Emergent.	Impacts are the same as described under each of the action alternatives.
Fish and Amphibians	Number of crossings of known and/or assumed anadromous fish streams.	N/A	40	43	270	Impacts are the same as described under each of the action alternatives.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Fish and Aquatics	Number of gravel mines within floodplain or in low-lying areas within 500 feet of fish streams/total number of gravel mines proposed.	N/A	21/41	22/46	16/44	Impacts are the same as described under each of the action alternatives.
Birds	Birds and bird habitat.	N/A	The impacts from a road on birds would include cut and fill in and alteration of terrestrial and aquatic habitat, disturbance and displacement of birds, and injury or mortality. The types of potential effects would be similar for each alternative, with different areas affected. Alternative A and B would have nearly identical impacts.	Same as Alternative A.	Similar to Alternative A, but Alternative C would be the longest alignment and would affect more habitat. It would affect an area noted for richness of waterfowl species and would cross more alpine habitat areas.	A thicker road embankment would mitigate impacts to permafrost, water quality, and aquatic habitats which would reduce indirect impacts on bird species and habitat quality.
Mammals	Caribou habitat affected – WAH.	N/A	Migratory: 1,287 acres Winter: 1,128 acres Peripheral: 1,745 acres Total: 4,161 acres	Migratory: 1,347 acres Winter: 1,128 acres Peripheral: 2,300 acres Total: 4,775 acres	Migratory: 419 acres Winter: 1,615 acres Peripheral: 2,086 acres Total: 4,120 acres	The acreage of habitat impacted would be the same as described for each of the action alternatives.
Mammals	Caribou habitat affected – RMH.	N/A	0 acres	0 acres	1,964 acres	The acreage of habitat impacted would be the same as described for each of the action alternatives.
Land	Land ownership of proposed ROW (generally 250 feet wide; where footprint is outside this area, the ROW is considered to be 10 feet beyond the footprint).	N/A	Federal: 3,498 acres State: 8,635 acres Borough: 261 acres Alaska Native Corporation: 2,439 acres Native Allotment: 0.05 acres Private: 0 acres Undetermined: 42 acres Total: 14,874 acres	Federal: 3,083 acres State: 10,148 acres Borough: 593 acres Alaska Native Corporation: 2,437 acres Native Allotment: 0.44 acres Private: 0 acres Undetermined: 45 acres Total: 16,306 acres	Federal: 19,090 acres State: 426 acres Borough: 0 acres Alaska Native Corporation: 3,390 acres Native Allotment: 12 acres Private: 152 acres Undetermined: 73 acres Total: 23,143 acres	Impacts are the same as described under each of the action alternatives.
Land	Miles of proposed ROW within special designation areas.	N/A	29 miles (GAAR, Special Recreation Management Area, Kobuk Wild and Scenic River)	21 miles (GAAR, Special Recreation Management Area, Kobuk Wild and Scenic River)	105 miles (Tozitna River and Indian River Areas of Critical; Environmental Concern, Special Recreation Management Area)	Impacts are the same as described under each of the action alternatives.
Transportation and Access	Total transport distance, Ambler Mining District to port at Anchorage -portion assumed by truck -portion assumed by rail	N/A	808 miles -452 miles by truck -356 miles by rail	825 miles -469 miles by truck -356 miles by rail	828 miles -472 miles by truck -356 miles by rail	Impacts are the same as described under each of the action alternatives.
Transportation and Access	Direct effect: AADT on the Ambler Road over the 50-year term of the ROW permit (based on assumed mining scenario in Appendix H, Indirect and Cumulative Impacts).	N/A	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day	Phase 1: 7–57 trips per day Phase 2: 58–118 trips per day Phase 3 (early): 104–168 trips per day Phase 3 (late): 83, tapering to 3, trips per day	The reduced construction duration would result in average construction traffic volumes increasing by 33 percent compared to the phased construction options; approximately the same number of trips would be required, but they would be condensed from a 4-year duration to a 3-year duration.
Transportation and Access	Indirect effect: AADT increase on Dalton Highway (current AADT is 300 (projected traffic level is the same for all action alternatives).	N/A	Dalton Highway miles affected: 161 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day	Dalton Highway miles affected: 161 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day	Dalton Highway miles affected: 59.5 Phase 1: 7–57 trips per day Phase 2: 58–179 trips per day Phase 3 (early): 160–238 trips per day Phase 3 (late): 123, tapering to 3, trips per day	Miles affected would be the same as described under each of the action alternatives. There would likely be heavier construction traffic along the Steese, Elliott, and Dalton Highways from Fairbanks to the Ambler Road corridor during winter months.
Transportation and Access	Indirect effect: new rail and port traffic associated with 4 likely mines (same for all action alternatives).	N/A	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year	Arctic: 4.3 trains per week; 10 ships per year Bornite: 2.2 trains per week; 5 ships per year Sun: 1.5 trains per week; 3 ships per year Smucker: 1.5 trains per week; 3 ships per year	Impacts are the same as described under each of the action alternatives.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Transportation and Access	Communities most likely to arrange commercial deliveries directly or by connecting boat or snowmobile.	N/A	Direct: Kobuk Via connecting boat or snowmobile: Shungnak, Ambler, Bettles-Evansville	Direct: Kobuk Via connecting boat or snowmobile: Shungnak, Ambler, Bettles-Evansville	Direct: Kobuk Via new road: Hughes Via connecting boat or snowmobile: Shungnak, Ambler	Impacts are the same as described under each of the action alternatives.
Recreation and Tourism	Recreational River Float Route Crossings	N/A	Alatna River (downstream of Wild and Scenic River portion) John River (downstream of Wild and Scenic River portion) Kobuk River (at Wild and Scenic River portion) North Fork Koyukuk (downstream of Wild and Scenic River portion) The alternative crosses multiple other streams and rivers used for float trips but that originate outside GAAR and have no "wild and scenic" segment.	Alatna River (downstream of Wild and Scenic River portion) John River (downstream of Wild and Scenic River portion) Kobuk River (at Wild and Scenic River portion) North Fork Koyukuk (downstream of Wild and Scenic River portion) The alternative crosses multiple other streams and rivers used for float trips but that originate outside GAAR and have no "wild and scenic" segment.	Kobuk (downstream of Wild and Scenic River segment) The alternative crosses multiple other streams and rivers used for float trips and boating but that originate outside GAAR and have no "wild and scenic" segment, including the Koyukuk and Hogatza.	The impacts would be the same for each alternative. However, construction impacts (e.g., increased noise and presence of workers) would be more short-lived and limited in scope.
Visual Resources	Miles of road alignment within BLM VRI classifications (broad indicator of visual value without management implications).	N/A	BLM VRI Class I: 0 miles BLM VRI Class II: 107.3 miles BLM VRI Class III: 0 miles BLM VRI Class IV: 21.5 miles Unclassified (GAAR): 26.1 miles Unclassified (Other): 56.4 miles	BLM VRI Class I: 0 miles BLM VRI Class II: 119.3 miles BLM VRI Class III: 0 miles BLM VRI Class IV: 25.7 miles Unclassified (GAAR): 17.8 miles Unclassified (Other): 65.5 miles	BLM VRI Class I: 0 miles BLM VRI Class II: 75.5 miles BLM VRI Class III: 64.4 miles BLM VRI Class IV: 168.7 miles Unclassified (GAAR): 0 miles Unclassified (Other): 23.9 miles	Impacts are the same as described under each of the action alternatives.
Visual Resources	Miles of road alignment within BLM VRM classifications (indicator of consistency with management plan near Dalton Highway).	N/A	BLM VRM Class I/II: 0 miles BLM VRM Class III: 16.9 miles BLM VRM Class IV: 1.9 miles	BLM VRM Class I/II: 0 miles BLM VRM Class III: 16.9 miles BLM VRM Class IV: 1.9 miles	BLM VRM Class I/II: 0 miles BLM VRM Class III: 7.9 miles BLM VRM Class IV: 4.4 miles	Impacts are the same as described under each of the action alternatives.
Socioeconomics and Communities	Direct road construction jobs (assuming each alternative would be built in 4 years).	N/A	Road construction total jobs per year: 750 Portion of total jobs to Alaskans: 620 Portion of total jobs to area residents: 120 Road operations jobs: 40 Portion of operations jobs to area residents: 8	Road construction total jobs per year: 800 Portion of total jobs to Alaskans: 660 Portion of total jobs to area residents: 130 Road operations jobs: 40 Portion of operations jobs to area residents: 8	Road construction total jobs per year: 1,440 Portion of total jobs to Alaskans: 1,180 Portion of total jobs to area residents: 240 Road operations jobs: 50 Portion of operations jobs to area residents: 10	The anticipated total workforce requirements would be the same as described for each action alternative but number of workers per year would be higher for the first years of construction.
Socioeconomics and Communities	Public Health	N/A	Increased employment and income could reduce food-insecurity but could alter diets away from healthier traditional diets to less healthy 'store-bought' diets, which can contribute to obesity and diabetes. The road could lead to increased exposure to asbestos, particularly for those who regularly travel/hunt & gather/work on or near the road and breathe dust. Road access/commercial deliveries and influx of road and mine workers would create easier access to abusable substances and could increase communicable disease if residents and workers mingle. If communities connected to the project fiber optic line, the connection could improve access to telemedicine until the road closed. See also Health Impact Assessment at project ePlanning web site. Communities most affected: Kobuk, Shungnak, Ambler, Bettles, Evansville.	Same as Alternative A. Communities most affected: Kobuk, Shungnak, Ambler, Bettles, Evansville.	Same as Alternative A, except potentially lower potential for asbestos to be released in road dust. Communities most affected: Kobuk, Shungnak, Ambler, Hughes.	Impacts are the same as described under each of the action alternatives.

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Socioeconomics and Communities	Indirect effects of mines in the District.	N/A	The mines would create new jobs and pay fees and taxes to the State of Alaska, Northwest Arctic Borough, and Native corporations. This would occur equally under all action alternatives. See also Transportation and Access for individual communities that could have cheaper commercial delivery of goods. This impact would occur during road operations, but the jobs could lead to decreased population in some small communities due to urban migration.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Environmental Justice	Disproportionate, adverse effects to minority and low-income populations.	N/A	Impacts to subsistence and public health, including stress, subsistence-food insecurity, and potential exposure to asbestos, would disproportionately affect low-income and minority populations, specifically Alaska Native villages that live in and near the project area and depend on the surrounding area for their subsistence lifeway. Impacts to cultural resources would have disproportionately high and adverse effect on local Tribal populations. All disproportionately high and adverse effects to minority or low-income populations would be long to permanent in duration. The effects would be more likely for Evansville under Alternative A and less likely for Hughes. Beneficial impacts to employment would occur but would not be expected to disproportionately affect low-income and minority populations.	Same as Alternative A.	Same as Alternative A, but the effects would be more likely for Hughes under Alternative C and less likely for Evansville.	Impacts are the same as described under each of the action alternatives.
Subsistence	Number of communities with subsistence use areas that would be crossed by the project, affecting subsistence travel patterns and subsistence species movements.	N/A	Moose: 9 Caribou: 9 Dall sheep: 6 Bear: 5 Small land mammals: 8 Migratory birds: 6 Upland game birds: 4 Eggs: 2 Salmon: 3 Other fish: 3 Vegetation: 6	Moose: 9 Caribou: 9 Dall sheep: 6 Bear: 5 Small land mammals: 9 Migratory birds: 5 Upland game birds: 4 Eggs: 2 Salmon: 3 Other fish: 3 Vegetation: 7	Moose: 8 Caribou: 10 Dall sheep: 3 Bear: 7 Small land mammals: 15 Migratory birds: 6 Upland game birds: 3 Eggs: 0 Salmon: 5 Other fish: 8 Vegetation: 6	Impacts are the same as described under each of the action alternatives.
Subsistence	Communities with impacts to 5 or more of their subsistence use areas, PLUS number of other communities with impacts to fewer subsistence use areas	N/A	Seven communities: Ambler, Bettles, Coldfoot, Evansville, Kobuk, Shungnak, Wiseman, PLUS 5 other communities (12 total)	Eight communities: Alatna, Ambler, Bettles, Coldfoot, Evansville, Kobuk, Shungnak, Wiseman, PLUS 4 other communities (12 total).	Seven communities: Alatna, Allakaket, Ambler, Hughes, Kobuk, Shungnak, Stevens Village, PLUS 5 other communities (12 total).	Communities affected would be the same as described for each action alternative. The reduced duration of construction may lessen, but not eliminate, subsistence user concerns related to fish and water impacts.
Subsistence	Alternative passes through primary migratory range of the WAH.	N/A	Yes	Yes	No	Impacts are the same as described under each of the action alternatives.
Subsistence	Caribou is a resource of high importance for potentially affected communities	N/A	25 communities	Same as Alternative A	Same as Alternative A	Same as Alternative A
Subsistence	Fish is a resource of high importance for potentially affected communities	N/A	24 communities	Same as Alternative A	Same as Alternative A	Same as Alternative A

Resource category	Resource affected	No Action Alternative	Alternative A	Alternative B	Alternative C	Combined Phasing Option
Cultural Resources	Number of cultural sites and potentially historic trails in the proposed ROW and the 10-mile wide affected area	N/A	ROW Corridor: 12 sites, 6 trails Affected Area: 309 sites, 10 trails	ROW Corridor: 7 sites, 6 trails Affected Area: 148 sites, 10 trails	ROW Corridor: 5 sites, 7 trails Affected Area: 62 sites,10 trails	The number of cultural sites and trails affected would be the same as described for each action alternative. However, the duration for construction-related noise impacts to culturally sensitive areas and resources and increased access impacts from construction workers would be reduced.
Cultural Resources	Number of documented line or point place names in the proposed ROW and the 10-mile wide affected area	N/A	ROW Corridor: 16 lines Affected Area: 35 points and 45 lines	ROW Corridor: 18 lines Affected Area: 35 points and 47 lines	ROW Corridor: 26 lines and 1 point Affected Area: 94 points and 69 lines	The number of place names affected would be the same as described for each action alternative. However, the duration for construction-related noise impacts to culturally sensitive areas and resources and increased access impacts from construction workers would be reduced.
Cultural Resources	Ethnographic resources that are within the 10-mile wide affected area for each Alternative.	N/A	Several camps; traditional bear, sheep, and trapping areas; 3 portages; a traditional use area near a Native allotment; a place of cultural transmission at a Native allotment; a traditional trail; a historic caribou hunting area; a dugout/hideout location; and a Kobuk Sacred Site. The Jim River ACEC Expansion nomination area is crossed by Alternative A and the nominated Koyukuk River Tributaries ACEC and Huslia ACEC are downstream of this alternative.	Same as Alternative A	A historic trail, the Koyukuk River Tributaries ACEC, and the Huslia ACEC.	The number of ethnographic resources affected would be the same as described for each action alternative. However, the duration for construction-related noise impacts to culturally sensitive areas and resources and increased access impacts from construction workers would be reduced.

Source: Analysis by BLM.

Notes: AADT = Annual Average Daily Traffic; APE = Area of Potential Effect; ARD = acid rock drainage; BLM = Bureau of Land Management; CO2e = carbon dioxide equivalent; District = Ambler Mining District; GAAR = Gates of the Arctic National Park and Preserve; GHG = greenhouse gas; N/A = not applicable; NOA = naturally occurring asbestos; PFYC = Potential Fossil Yield Classification; RMH = Ray Mountains Herd; ROW = right-of-way; VRI = Visual Resource Inventory; VRM = Visual Recreation Management; WAH = Western Arctic Caribou Herd

2. References

DOWL. 2016. Ambler Mining District Industrial Access Road SF299 Revised Permit Application. Prepared for the Alaska Industrial Development and Export Authority. Available at: eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=111130.

DOWL. 2019a. Ambler Mining District Industrial Access Project SF299 Application Communications Amendment. April 2019. Prepared for AIDEA by DOWL. Anchorage, Alaska.

DOWL. 2019b. *Ambler Mining District Industrial Access Project: Summary Report Addendum*. Prepared for AIDEA by DOWL. Anchorage, Alaska.

DOWL. 2023. Ambler Road Supplemental EIS, Alternative Cost Estimate Updates. Prepared for BLM by DOWL. August 16, 2023.

USACE (U.S. Army Corps of Engineers). 2020. POA-2013-00396, Kobuk, Alatna, and Koyukuk Rivers Section 404 Permit. Fairbanks, Alaska.

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1. Affected Environment and Environmental Consequences – Physical Environment

1.1. Geology and Soils

Table 1 identifies the geologic units crossed by the alternative footprints in the project area. The largest unit is unconsolidated surficial deposits, which predominantly consists of alluvial and glacial deposits.

Table 1. Geologic units crossed by alternative footprints

State unit	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Andesitic volcanic rocks	0	0	162
Calcareous graywacke and conglomerate	9	125	1,096
Dikes and subvolcanic rocks	0	0	13
Igneous rocks	130	210	1,214
Intermediate granitic rocks	0	0	19
Mafic igneous-clast conglomerate, sandstone, and mudstone	111	111	0
Marble, northern Alaska	7	10	68
Melange facies	7	92	0
Metagraywacke and phyllite	34	31	9
Pelitic and quartzitic schist of the Ruby terrane	0	0	256
Pyroclastic rocks	0	0	216
Quartz-mica schist of the Brooks Range	104	104	73
Quartz-pebble conglomerate, west-central Alaska	32	77	60
Unconsolidated surficial deposits, undivided	4,084	4,370	4,455
Volcanic graywacke and conglomerate	0	0	143
Water	6	7	19
Total acres	**4,524**	**5,138**	**8,210**

Source: USGS n.d.

Note: The total acreage of Alternative C includes a 406-acre area undefined by a state unit or waterbody.

Table 2 identifies the footprint acreage and percentage within mapped permafrost areas.

Table 2. Acreage and percent of alternative footprint within mapped permafrost areas

Permafrost	Alternative A (acres)	Alternative A (%)	Alternative B (acres)	Alternative B (%)	Alternative C (acres)	Alternative C (%)
Mountainous Area underlain by continuous permafrost	3,510	78	3,738	73	283	3

Permafrost	Alternative A (acres)	Alternative A (%)	Alternative B (acres)	Alternative B (%)	Alternative C (acres)	Alternative C (%)
Mountainous Area underlain by discontinuous permafrost	0	0	0	0	3,031	37
Lowland and Upland Area underlain by moderately thick to thin permafrost	667	15	953	19	3,662	45
Lowland and Upland Area underlain by discontinuous permafrost	347	8	447	9	1,234	15
Total	**4,524**	**100**	**5,138**	**100**	**8,210**	**100**

Source: Georeferences map and attribute data derived from Ferrians 1965

Note: Totals may exceed 100 percent due to rounding. The lowland and upland area underlain by moderately thick to thin permafrost is considered continuous permafrost for summation purposes.

Table 3 identifies the acreage and percentage of each alternative footprint on the mapped asbestos potential in the project area.

Table 3. Asbestos potential of alternative footprint

Naturally occurring asbestos potential	Alternative A (acres [% total])	Alternative B (acres [% total])	Alternative C (acres [% total])
High	88 (2)	168 (3)	0 (0)
Medium	106 (2)	198 (4)	1,279 (16)
Zero to low	202 (4)	367 (7)	2,267 (28)
Unknown (unevaluated surficial deposits)	4,120 (91)	4,395 (86)	4,645 (57)
Other/Water	8 (<1)	9 (<1)	20 (<1)
Total	**4,524 (100)**	**5,138 (100)**	**8,210 (100)**

Source: Solie and Athey 2015

1.2. Sand and Gravel Resources

No tables or supplemental information.

1.3. Hazardous Waste

Table 4 lists Alaska Department of Environmental Conservation (ADEC) identified contaminated sites located within 5 miles of Alternative C. There are no sites located within 5 miles of Alternatives A and B. Volume 4, Map 3-3 depicts this information.

Table 4. ADEC identified contaminated sites in the study area

ADEC Hazard ID	Site name	Status	Distance from Alternative C (miles)
23352	BLM Fire Service Dahl Creek	Cleanup Complete	0.9

ADEC Hazard ID	Site name	Status	Distance from Alternative C (miles)
25387	Alyeska Five Mile Airstrip	Cleanup Complete	1.3
3100	DOT&PF SREB - Kobuk	Active	1.5
4615	Kobuk Abandoned Tank Farm	Active	1.5
26573	DOT&PF 7 Mile Maintenance Station Class V Injection Well	Active	1.9
24594	DOT&PF 7 Mile Maintenance Station	Cleanup Complete – Institutional Controls	2.0
873	DOT&PF 7 Mile Camp	Cleanup Complete – Institutional Controls	2.0
1078	Central Alaska Gold Company	Cleanup Complete	3.2
1601	Hughes Power Plant Pipeline	Active	3.2
2645	Hughes School and Community Tank Farm	Active	3.4
26270	Alyeska PS 06 Former Fire Training Area	Active	4.3
4611	Alyeska PS 06 Former Mainline Turbine Sump	Cleanup Complete	4.4
2965	Alyeska PS 06 Leach Field/Fuel Island	Active	4.4
2529	Alyeska PS 06 Therminol Spill Site	Cleanup Complete – Institutional Controls	4.4
3115	Alyeska PS 06 Jet Shed	Cleanup Complete – Institutional Controls	4.4
1437	Alyeska PS 06 JP4 Fueling Facility	Cleanup Complete	4.4
1731	Alyeska PS 06 Former Turbine Fuel Loading	Cleanup Complete – Institutional Controls	4.4

Source: ADEC 2019

Note: ADEC = Alaska Department of Environmental Conservation; BLM = Bureau of Land Management; DOT&PF = Alaska Department of Transportation and Public Facilities; ID = Identification; PS = Pump Station; SREB = snow removal equipment building

Table 5 describes characteristics of spill conditions and descriptions by season.

Table 5. Spill characteristics by seasons

Season	Conditions	Description
Summer (ice-free)	Most rivers and creeks are ice-free or flowing; ponds and lakes are open water; tundra is snow-free; and biological use of tundra and water bodies is high.	Currents, winds, and passive spreading forces would disperse spills that reach the water bodies. Spills to the tundra would directly affect the vegetation, although dispersal of the spilled material is likely to be impeded by the vegetation. Spills to wet tundra may float on the water or be dispersed over a larger area than would spills to dry tundra or to snow-covered tundra. Spills under pressure that spray into the air may be distributed downwind over substantial areas and affect the tundra vegetation and water bodies.
Fall (freeze-up)	Waterbodies are beginning to ice over, but the ice cover might vary, depending on temperature, wind, currents, and river flow velocities. Snow begins to cover the tundra, and most of the migratory birds are leaving the North Slope.	Spilled material could be dispersed when it reaches flowing water but slowed or stopped when it reaches snow or surface ice. The spilled material could be contained by the snow or ice but dispersed if the ice breaks up and moves before it refreezes. The spilled material also could flow into ice cracks to the underlying water, where it could collect.

Season	Conditions	Description
Winter (ice cover)	Waterbodies are covered by mostly unbroken ice, and snow covers the tundra.	Dispersal of material spilled to the tundra generally would be slowed although not necessarily stopped by the snow cover. Depending on the depth of snow cover as well as temperature and volume of spilled material, it may reach the underlying dormant vegetation or tundra ponds and lakes. Similarly, spills to rivers and creeks generally would be restricted in distribution by the snow and ice covering the waterbody, compared to seasons when there is no snow or ice cover. Spills under the ice to creeks, rivers, and tundra ponds and lakes might disperse slowly, as the currents are generally slow to nonexistent in winter.
Spring (breakup)	Thawing begins in the higher foothills of the Brooks Range and river flows increase substantially and quickly, often to flood stages. This is a short period of the year. These increased flows cause river ice cover to break up and flow downriver. River floodwaters usually flow over sea ice, which hastens the breakup of the sea ice. Snow cover begins to melt off the tundra and many migratory species, especially birds, return to the tundra.	Spills to waterbodies during breakup are likely to be widely dispersed and difficult to contain or clean up. Spills to the tundra might be widely dispersed if the flooding overtops the river and creek banks and entrains the spilled material.

Source: Coastal Plain Draft EIS (BLM 2019), based on Alpine Satellite Development Plan EIS (BLM 2004)

1.4. Paleontological Resources

The Potential Fossil Yield Classification (PFYC) system allows BLM employees to make initial assessments of paleontological resources to analyze potential effects of a proposed action under the National Environmental Policy Act. The PFYC system can also highlight areas for paleontological research efforts or predict illegal collecting. The system provides a consistent approach to determine in a potential action may affect paleontological resources.

Occurrences of paleontological resources are known to be correlated with mapped geologic units. The PFYC is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geologic unit. PFYC assignments should be considered as only a first approximation of the potential presence of paleontological resources, subject to change, based on ground verification.

Table 6 descriptions for the class assignments below are guidelines. The assignments were developed by BLM for geologic units within the Central Yukon Planning Area boundary, using criteria outlined in BLM Permanent Instruction Memorandum 2022-009 and are summarized in the following table.

Table 6. PFYC system description

Class	PYFC system description
Class 1 – Very Low	These are geologic units that are not likely to contain recognizable paleontological resources. Management concerns for paleontological resources in Class 1 units are usually negligible or not applicable. Paleontological mitigation is unlikely to be necessary, except in very rare or isolated circumstances that result in the unanticipated presence of paleontological resources, such as unmapped geology contained in a mapped geologic unit. The probability of affecting significant paleontological resources is very low, and further assessment of paleontological resources is usually unnecessary. An assignment of Class 1 normally does not trigger a further analysis, unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized, in order to accommodate an unanticipated discovery.

Class	PYFC system description
Class 2 – Low	This is assigned to geologic units that are not likely to contain paleontological resources. Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist. The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.
Class 3 – Moderate	This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Except where paleontological resources are known or found to exist, management concerns for paleontological resources are generally low and further assessment is usually unnecessary, except in occasional or isolated circumstances. Paleontological mitigation is necessary only where paleontological resources are known or found to exist. The probability of affecting significant paleontological resources is low. Localities containing important paleontological resources may exist, but they are occasional and should be managed on a case-by-case basis. An assignment of Class 2 may not trigger further analysis unless paleontological resources are known or found to exist; however, standard stipulations should be put in place before any land use action is authorized to accommodate unanticipated discoveries.
Class 4 – High	This is assigned to geologic units that are known to contain a high occurrence of paleontological resources. Management concerns for paleontological resources in Class 4 are moderate to high, depending on the proposed action. Paleontological mitigation strategies will depend on the nature of the proposed activity, but field assessment by a qualified paleontologist is normally needed to assess local conditions. The probability for affecting significant paleontological resources is moderate to high and depends on the proposed action. Mitigation planners must consider the nature of the proposed disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access that could result in looting. Detailed field assessment is normally required and on-site monitoring or spot-checking may be necessary during land-disturbing activities. In some cases, avoiding known paleontological resources may be necessary.
Class 5 – Very High	This is assigned to sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Management concerns for paleontological resources are moderate because the existence of significant paleontological resources is known to be low. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for casual collecting. Paleontological mitigation strategies will be proposed, based on the nature of the proposed activity. This classification includes units of moderate or infrequent occurrence of paleontological resources. Management considerations cover a broad range of options that may include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Surface-disturbing activities may require assessment by a qualified paleontologist to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.
Class U – Unknown Potential	These are such geologic units that cannot receive an informed PFYC assignment. Until a provisional assignment is made, geologic units that have an unknown potential have medium to high management concerns. Lacking other information, field surveys are normally necessary, especially before a ground-disturbing activity is authorized. An assignment of Class U may indicate the unit or area is poorly studied, and field surveys are needed to verify the presence or absence of paleontological resources. Literature searches or consultation with professional colleagues may allow an unknown unit to be provisionally assigned to another PFYC, but the geological unit should be formally assigned to a class after adequate survey and research is performed to make an informed determination.
Class W – Water	This class is assigned to any surface area that is mapped as water. Most bodies of water do not normally contain paleontological resources; however, shorelines should be carefully considered for uncovered or transported paleontological resources.

Source: BLM 2022

Note: PFYC = Potential Fossil Yield Classification

Table 7 summarizes the PFYC acreages for the project construction footprints of each action alternative.

Table 7. PFYC acreages by alternative

PFYC	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Class 1 – Very Low	306	514	2,023
Class 2 – Low	4,212	4,617	5,762
Class 3 – Moderate	0	0	0
Class 4 – High	0	0	0
Class 5 – Very High	0	0	0
Class W – Water	6	7	19
Class U – Unknown Potential	0	0	406
Total	**4,524**	**5,138**	**8,210**

Source: USGS Scientific Investigations Map 3340, Geological Map of Alaska, GIS Data accessed online at https://mrdata.usgs.gov/sim3340/, PFYC rankings for the Central Yukon Management Planning area assigned by BLM Regional Paleontologist, March 2019. Per BLM IM 2016-124, Class U (unknown potential) has moderate-high management concerns until evaluation is performed (BLM 2016).

Note: PFYC = Potential Fossil Yield Classification

1.5. Water Resources*

Table 8 summarizes temperature and precipitation levels at Coldfoot Station, including mean highs and lows, and number of years or values available for both.

Table 8. Monthly temperature and precipitation levels, Coldfoot Station*

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/ values (mean)	Number of years/ values (high)	Number of years/ values (low)	Number of years/ values (precip.)
January	-7.0	0.4	-14.1	0.84	28	28	28	28
February	-0.8	8.8	-9.1	1.19	27	28	28	28
March	7.0	21.2	-5.0	0.64	27	28	28	28
April	26.9	37.8	14.4	0.71	27	28	28	28
May	46.2	55.6	34.1	0.99	27	28	28	28
June	58.1	68.5	45.7	1.52	27	28	28	28
July	57.9	68.1	47.1	2.92	28	28	28	27
August	50.8	60.6	41.1	3.37	28	28	28	27
September	40.3	48.5	32.3	2.58	28	28	28	27
October	22.2	28.9	16.0	1.42	27	28	28	28
November	2.5	8.9	-4.1	0.90	27	28	28	28
December	-2.3	4.6	-9.0	1.14	27	28	28	28

Source: NCEI n.d.

Note: °F = degrees Fahrenheit; in. = inches; precip. = precipitation; temp. = temperature

Table 9 summarizes temperature and precipitation levels at Bettles Airport Station, including mean highs and lows, and number of years or values available for both. The meteorological record at Bettles Airport is extensive, and National Centers for Environmental Information (NCEI) has produced long-term

average daily values of maximum, minimum, and mean daily temperatures as well as mean daily precipitation and snowfall, presented as year-to-date values.

Table 9. Monthly temperature and precipitation levels, Bettles Airport Station*

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/values (mean temp.)	Number of years/values (precip.)
January	-8.0	-3.7	-19.7	0.78	23	72
February	-4.1	2.6	-16.5	0.78	23	72
March	5.8	15.2	-9.2	0.63	24	72
April	23.3	33.3	100.7	0.58	25	72
May	44.2	54.1	33.8	0.71	25	73
June	58.2	68.5	46.9	1.42	24.	73
July	60.1	69.6	48.9	2.11	22	71
August	52.3	62.4	43.2	2.60	20	72
September	40.6	49.1	32.4	1.96	20	72
October	23.9	26.6	13.1	1.17	21	72
November	2.5	6.4	-7.8	0.98	24	72
December	-5.2	-0.6	-15.9	1.00	23	72

Source: NCEI n.d.

Note: °F = degrees Fahrenheit; in. = inches; precip. = precipitation; temp. = temperature

Table 10 summarizes temperature levels at Hogatza River Station, including mean highs and lows, and number of years or values available for both.

Table 10. Monthly temperature levels, Hogatza River Station*

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Number of years/values (mean temp.)	Number of years/values (high temp.)	Number of years/values (low temp.)
January	-3.4	2.0	-9.3	26	26	26
February	3.3	11.9	-5.1	21	21	21
March	10.7	24.8	-1.8	20	20	20
April	28.7	42.5	15.6	20	20	20
May	47.4	60.2	33.7	31	31	31
June	59.3	72.6	45.2	35	35	35
July	60.4	72.0	48.3	34	34	34
August	53.6	65.8	43.0	34	34	34
September	42.1	52.5	33.6	30	30	30
October	24.7	32.2	18.2	30	30	30
November	6.9	13.3	0.4	30	30	30
December	2.2	7.3	-4.0	26	26	26

Source: NCEI n.d.

Note: °F = degrees Fahrenheit; temp. = temperature

Table 11 summarizes temperature and precipitation levels at Selawik Station, including mean highs and lows, and number of years or values available for both.

Table 11. Monthly temperature and precipitation levels, Selawik Station*

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Total precip. (in.)	Number of years/values (temp.)	Number of years/values (precip.)
January	-4.5	2.9	-12.0	0.31	8	8
February	-0.5	7.6	-8.5	0.32	8	8
March	5.4	13.9	-3.2	0.55	8	8
April	18.7	27.5	9.9	0.49	8	8
May	41.0	50.8	31.3	0.84	8	8
June	55.0	64.5	45.4	1.13	8	8
July	59.3	67.1	51.5	2.41	7	7
August	52.6	60.3	44.9	2.93	8	8
September	43.0	50.5	35.6	1.58	8	8
October	28.5	34.5	22.5	1.29	8	8
November	7.5	14.1	1.0	0.58	8	8
December	2.4	9.7	-4.9	0.87	8	8

Source: NCEI n.d.

Note: °F = degrees Fahrenheit; in. = inches; precip. = precipitation; temp. = temperature

Table 12 summarizes temperature levels at Kiana Station, including mean highs and lows, and number of years or values available for both.

Table 12. Monthly temperature levels, Kiana Station*

Month	Mean monthly temp. (°F)	Mean monthly high (°F)	Mean monthly low (°F)	Number of years/values
January	-2.1	3.7	-8.1	29
February	2.1	9.2	-5.2	25
March	7.2	17.0	-2.5	25
April	23.8	33.8	13.5	26
May	42.3	52.1	31.5	28
June	55.6	65.4	44.1	32
July	58.4	67.3	48.7	33
August	52.6	61.5	43.7	34
September	42.2	50.7	34.4	31
October	24.9	30.8	19.0	30
November	8.1	13.3	2.5	30
December	1.3	7.0	-5.1	28

Source: NCEI n.d.

Note: °F = degrees Fahrenheit; temp. = temperature

Table 13 lists the large rivers in the project area, including their headwater origin and receiving waters, drainage areas, and alternatives crossings.

Table 13. Large rivers in the project area*

Large river	Headwater origin	Receiving water	Route alternatives crossing
Koyukuk River	Chandalar Shelf/Brooks Range	Yukon River	A, B, C
Wild River	Brooks Range	Koyukuk River	A, B
John River	Brooks Range	Koyukuk River	A, B
Malamute Fork Alatna River	Brooks Range	Alatna River	A, B
Alatna River	Brooks Range	Koyukuk River	A, B
Indian River	Indian Mountains	Koyukuk River	C
Hughes Creek	Hogatza Hills	Koyukuk River	C
Hogatza River	Helpmejack Hills	Koyukuk River	B, C
Yukon River	Coastal Range, Northern British Columbia	Bering Sea	None
Ray River	Ray Mountains	Yukon River	C
Big Salt River	Ray Mountains	Yukon River	C
Tozitna River	Ray Mountains	Yukon River	C
Melozitna River	Slokhenjikh Hills	Yukon River	None
Kobuk River	Brooks Range	Chukchi Sea	A, B, C
Reed River	Brooks Range	Kobuk River	A, B
Beaver Creek	Brooks Range	Kobuk River	A, B
Mauneluk River	Brooks Range	Kobuk River	A, B
Kogoluktuk River	Brooks Range	Kobuk River	A, B
Shungnak River	Brooks Range	Kobuk River	A, B, C
Ambler River	Brooks Range	Kobuk River	None

Source: USGS n.d.

Hydrologic data within the project area are limited, with only 4 currently operating USGS gages: 15564879 Slate Creek at Coldfoot, 15743850 Dahl Creek near Kobuk, 15564900 Koyukuk River at Hughes, and 15453500 Yukon River near Stevens Village (at the Dalton Highway crossing). Additional information is available for discontinued USGS gages for 15564885 Jim River near Bettles, and 15564875 Middle Fork of the Koyukuk River near Wiseman. All but 1 station include water quality information. The U.S. Fish and Wildlife Service (USFWS) is currently monitoring 8 gage stations within the Kanuti National Wildlife Refuge (NWR), including the Koyukuk River near Bettles just downstream from its confluence with the John River. Table 14 summarizes drainage data from the U.S. Geological Survey (USGS) gages in the project area and vicinity, by station. Map 3-6 in Volume 4 depicts the locations of the gages.

Table 14. USGS gages in the project area and vicinity*

USGS ID	Station name and nearby town	Coordinates (NAV27)[a]	Drainage area (sq. mi.)	Period of record	Type of data
15453500	Yukon River near Stevens Village (Dalton Highway Crossing)	65°52'32" N 149°43'04" W (NAD27)	194,000	October 1991–current	Discharge, field measurements, water-quality measurements
15564875	Middle Fork of the Koyukuk River near Wiseman	67°26'18" N 150°04'30" W	1,170	January 1970–September 1987	Discharge, field measurements, water-quality measurements
15564879	Slate Creek at Coldfoot	67°15'16" N 150°10'38" W (NAD83)	73.1	May 1995–current	Discharge, temperature, field measurements, water-quality measurements
15564885	Jim River near Bettles	66°47'10" N 150°52'23" W	458	August 1970–September 1977	Discharge, field measurements, water-quality measurements
15564900	Koyukuk River at Hughes	66°02'51"N 154°15'30" W (NAD27)	17,990	January 1960–current	Discharge, field measurements, water-quality measurements
15743850	Dahl Creek near Kobuk	66°56'46" N 156°54'32" W	10.9	September 1994–current	Discharge, field measurements

Source: USGS 2019

Note: N = North; sq. mi. = square mile; USGS = U.S. Geological Survey; W = West

[a] NAV27 is used unless otherwise noted.

Kane et al. (2015) monitored gages and water quality at 5 river stations: the Koyukuk River near Bettles (in cooperation with the USFWS), the South Fork of Bedrock Creek (tributary to the Alatna), Alatna River, Kobuk River, and Reed River. The last 4 stations were close to the Alternative A alignment. Table 15 summarizes location information for the University of Alaska Fairbanks (UAF) Water and Environmental Research Center gages, by station. Volume 4, Map 3-5, depicts the locations of these gages.

Table 15. University of Alaska Fairbanks – Water and Environmental Research Center gages

Station	Basin	Location	Period of record	Data types[a]
Alatna River	Alatna	67.022°N 153.302°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Bettles	Koyukuk	66.9064°N 151.6772°W	September 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Reed River	Kobuk	66.9973°N 151.6772°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
S. Fork Bedrock Creek	Alatna	67.0924°N 152.7292°W	July 2012 to September 2014 (H) and August 2015 (M)	Hydrologic and meteorological
Upper Iniakuk	Alatna	67.1354°N 153.1354°W	July 2012 to Aug 2015	Meteorological
Upper Kogoluktuk	Kobuk	67.3071°N 156.2446°W	July 2012 to August 2015	Meteorological
Upper Reed	Kobuk	67.1853°N 154.9361°W	July 2012 to August 2015	Meteorological

Station	Basin	Location	Period of record	Data types[a]
Wild	Koyukuk	67.4152°N 151.6837°W	July 2012 to August 2015	Meteorological

Source: Kane et al. 2015

Note: H = Hydrological; M= Meteorological; N = North; W = West

Meteorological data include air temperature, relative humidity, wind speed, wind direction, snow depth, soil moisture, soil temperature, barometric pressure, net radiation, and rainfall. Four stations were close to the proposed Alternative A and B alignments, and 4 sites were farther north and upslope in the river basins to provide information on variations with altitude.

[a] Hydrologic data include water level, turbidity, suspended sediment, and water velocity.

Table 16 identifies Alaska Department of Natural Resources (ADNR)-listed permits, certificates, and pending actions for surface and subsurface water uses within approximately 5 miles of project alternatives. Note, the ADNR is the authority for private (non-public) well logs and water rights, and the ADEC is the authority for regulated public water system sources (e.g., wells, intakes, springs, rain catchments, and infiltration galleries).

Table 16. ADNR-listed surface and subsurface water uses*

Water type	ADNR file type and number	Name	Distance from alternative in miles	Description
Subsurface	ADL 400049	Helmericks	4.6 (Alternative A)	Drilled well, 500 GPD
Subsurface	LAS 21006	City of Kobuk	1.6 (Alternative C)	Public water supply for homes, water treatment plant, washateria, and school
Subsurface	LAS 3454	Bamford	1.8 (Alternative C)	Water withdrawn from drilled well and unnamed tributary to Hogatza River
Subsurface	ADL 67134	City of Hughes	3.3 (Alternative C)	Drilled well, 4,000 GPD
Subsurface	ADL 53264	Yukon Koyukuk School District	3.3 (Alternative C)	Drilled well for grade school, 5,000 GPD
Subsurface	LAS 6660	Alyeska Pipeline Services	0.5 (Alternative C)	Drilled well for Pump Station 6, 10,000 GPD
Subsurface	LAS 3037	Sukakpak Inc.	3.0 (Alternative C)	Drilled well at gas station, 8,000 GPD
Surface	ADL 75781	Stewart, deceased	4.8 (Alternative A), 4.8 (Alternative B), 2.9 (Alternative C)	Water for gold mining sourced from Dahl, Harry, and Wye creeks
Surface	TWUA P2018-128	City of Shungnak	5.2 (Alternative C)	Withdrawal from Kobuk River for public water supply, 16,000 GPD
Surface	TWUA F2022-027	Ambler Metals LLC	0.8 (Alternative C)	Camp uses at Dahl Creek camp and airstrip
Surface	TWUA F2021-038	Ambler Metals LLC	0.5 (Alternatives A and B)	Bornite Project drilling and camp use at unnamed creek
Surface	TWUA F2021-038	Ambler Metals LLC	0.4 (Alternatives A and B)	Bornite Project drilling and camp use at unnamed creek
Surface	TWUA F2021-038	Ambler Metals LLC	0.4 (Alternatives A and B)	Bornite Project drilling and camp use at unnamed ponds
Surface	TWUA F2021-038	Ambler Metals LLC	3.3 (Alternatives A and B)	Bornite Project drilling use at unnamed pond
Surface	TWUA F2021-038	Ambler Metals LLC	3.7 (Alternatives A and B)	Bornite Project drilling use at tributary to Kogoluktuk River
Surface	TWUA F2021-037	Ambler Metals LLC	1.0 (Alternative C)	Bornite Project drilling and camp use at Jay Creek

Water type	ADNR file type and number	Name	Distance from alternative in miles	Description
Surface	TWUA F2021-037	Ambler Metals LLC	0.02 (Alternative C)	Bornite Project drilling and camp use at Ruby Creek
Surface	TWUA F2021-037	Ambler Metals LLC	0.7 (Alternative C)	Bornite Project drilling and camp use at Wesley Creek
Surface	TWUA F2021-037	Ambler Metals LLC	0.2 (Alternative C)	Bornite Project drilling and camp use at Ruby Creek
Surface	TWUA F2021-037	Ambler Metals LLC	0.4 (Alternative C)	Bornite Project drilling and camp use at Cabin Creek
Subsurface	TWUA F2021-039	Ambler Metals LLC	0.2 (Alternative C)	Well for Bornite Camp
Subsurface	TWUA F2021-039	Ambler Metals LLC	0.3 (Alternative C)	Well for Bornite Camp
Surface	TWUA 2022-044	Valhalla Metals AK, INC	3.4 (Alternatives A and B)	Sun Project water for mineral exploration and camp use from unnamed tributary to Beaver Creek
Surface	TWUA 2022-044	Valhalla Metals AK, INC	3.1 (Alternatives A and B)	Sun Project water for mineral exploration and camp use from unnamed tributary to Beaver Creek
Surface	TWUA 2022-044	Valhalla Metals AK, INC	0.1 (Alternatives A and B)	Sun Project water for camp use at Beaver Creek
Reservation of Water	LAS 30712	ADFG	0.8 (Alternatives A and B)	Instream flow reservation for Middle Fork Koyukuk River

Source: ADNR 2019, 2023

Notes: ADL = Alaska Division of Lands; ADNR = Alaska Department of Natural Resources; GPD = gallons per day; LAS = Land Administration System; TWUA = Temporary Water Use Authorization

Table 17 estimates floodplain area impacted by the installation of crossing structures. In the absence of specific 100-year floodplain data for each waterbody, floodplain area impacts were estimated using the proposed number, size, and length of crossing structures. The average culvert length is assumed to be 96 feet, which is the proposed typical Phase III road width (32 feet lane road surface width, constructed with 8 feet of fill and 4:1 slopes). Minor culverts are assumed to be 3 feet in diameter, moderate culverts are 10 feet in diameter, and major culverts are 20 feet in diameter. Small bridges are assumed to be 50 feet long, medium bridges are assumed an average of 120 feet long, and large bridge lengths are calculated based on estimated individual bridge lengths. Floodplain impact width is 3 times the culvert diameter/bridge length, and floodplain impact length extends 5 times the culvert diameter/bridge length upstream and downstream of the crossing structure.

Table 17. Approximated floodplain area impacts by crossing structures*

Structure type	Alternative A	Alternative B	Alternative C
Number of minor culverts (≤ 3 feet)	2,864	3,150	4,076
Number of moderate culverts (≤ 10 feet)	7	5	131
Number of major culverts (≤ 20 feet)	12	9	141
Number of small bridges (≤ 50 feet)	22	18	79
Number of medium bridges (≤ 140 feet)	16	12	158
Number of large bridges (≥ 140 feet)	11	11	14

Structure type	Alternative A	Alternative B	Alternative C
Approximated floodplain area impacted by culverts (acres)	81.5	86.7	181
Approximated floodplain area impacted by bridges (acres)	2,071	2,047	4,345
Total approximated floodplain impacts (acres)	2,153	2,133	4,526

Source: AIDEA; USACE

Note: This analysis has been performed to estimate relative impacts. Hydrology investigations during design would inform the specific number, placement and size of each crossing structure to be constructed.

Table 18 summarizes water quality impacts estimated based on the miles of roadway embankment either in the floodplain or within 1,000 feet of the mapped floodplain. This analysis seeks to include impacts associated with linear infrastructure construction alongside water bodies. Embankment erosion and spills would have a higher likelihood to enter rivers and streams within 1,000 feet of floodplain. In the absence of specific 100-year floodplain data, the impacts were estimated by the intersection of the floodplain vegetation mapping layer with the alignment footprint (assumed applicable to large bridges only). For medium bridges, small bridges, major culverts, moderate culverts, and minor culverts where floodplain mapping is limited, the length of the roadway embankment in the floodplain was estimated as 3 times the culvert diameter/bridge length, consistent with calculations for Table 17.

Table 18. Roadway impacts on water quality*

Measurement	Alternative A	Alternative B	Alternative C
Miles of alignment in the floodplain (including crossings)	11.6	12.4	77.7
Miles of alignment located within 1,000 feet of mapped floodplain	16.1	17.3	96.3
Total miles of alternative	211	228	332
Percent alternative in the floodplain (including crossings)	5.5%	5.4%	23.4%
Percent alternative located within 1,000 feet of mapped floodplain	7.6%	7.6%	29.0%

Note: Floodplain impacts are estimated by the floodplain vegetation mapping layer intersected by the alignment alternatives; miles of alignment within 1,000 feet of floodplain includes the miles that are in the floodplain. Floodplain impacts for crossings where vegetative floodplain mapping is limited are estimated as 3 times the diameter of the culvert or length of the bridge.

1.6. Acoustical Environment (Noise)

Table 19 summarizes noise levels generated by individual pieces of typical construction equipment and construction operations. These include stationary noise equipment such as generators and pumps that produce constant levels of noise, and jackhammers and pile drivers that produce impulsive, high-intensity, short-duration noise levels. Mobile equipment such as trucks and earth moving equipment can have different power cycles and is expected to move locations over time. Noise levels are reported at 50 feet, and attenuate over distance. See Attachment A, Predictive Noise Modeling of the Ambler Road, for further information.

Table 19. Construction equipment noise emission reference levels

Equipment description	Impact device?	Lmax at 50 feet (dBA)
Auger drill rig, rock drill	No	85
Blasting	Yes	94
Compactor (ground)	No	80
Dozer, excavator, grader, scraper, other (greater than 5 HP)	No	85
Drill rig, dump, or flatbed trucks	No	84
Front end loader	No	80
Generator	No	82
Impact pile driver	Yes	95
Jackhammer	Yes	85
Pickup truck	No	55
Pneumatic tools	No	85
Pumps	No	77
Vibratory pile driver	No	95
Warning horn	No	85

Source: FHWA 2006: Table 9.1
Note: dBA = A-weighted decibels; HP = horsepower; L_{max} = maximum noise level

1.7. Air Quality and Climate

The National Ambient Air Quality Standards (NAAQS) are federal standards for pollutants considered harmful to human health and the environment, and are regulated by the Environmental Protection Agency (EPA) under the Clean Air Act (42 U.S. Code 7401 et seq.). NAAQS are applied for outdoor air throughout the country. Primary standards are designed to protect human health, with an adequate margin of safety, including sensitive populations such as children, the elderly, and individuals suffering from respiratory diseases. Secondary standards are designed to protect public welfare, damage to property, transportation hazards, economic values, and personal comfort and well-being from any known or anticipated adverse effects of a pollutant. A district meeting a given standard is known as an "attainment area" for that standard, and otherwise a "non-attainment area." The Ambler Road EIS project area is considered an attainment area.

ADEC Division of Air Quality (DAQ) assesses compliance with the NAAQS and Alaska Ambient Air Quality Standards (AAAQS) and works to ensure that the State of Alaska meets health-based air quality standards to protect public health and the environment. Table 20 summarizes both the NAAQS and AAAQS.

Table 20. NAAQS and AAAQS

Pollutant	Averaging period	NAAQS (40 CFR 50)	AAAQS (18 AAC 50)
NO_2	1 hour[a]	100 ppb (188 μg/m^3)	188 μg/m^3
NO_2	Annual[b]	53 ppb (100 μg/m^3)	100 μg/m^3
PM_{10}	24 hour[c]	150 μg/m^3	150 μg/m^3

Pollutant	Averaging period	NAAQS (40 CFR 50)	AAAQS (18 AAC 50)
$PM_{2.5}$	24 hour[d]	35 µg/m³	35 µg/m³
$PM_{2.5}$	Annual[e]	12 µg/m³	12 µg/m³
SO_2	1 hour[f]	75 ppb (196 µg/m³)	196 µg/m³
SO_2	3 hour[g]	0.5 ppm (1,300 µg/m³)	1,300 µg/m³
SO_2	24 hour[g]	N/A[h]	365 µg/m³
SO_2	Annual[b]	N/A[h]	80 µg/m³
CO	1 hour[g]	35 ppm (40 mg/m³)	40 mg/m³
CO	8 hour[g]	9 ppm (10 mg/m³)	10 mg/m³
O_3	8 hour[i]	0.070 ppm	0.070 ppm
NH_3	8 hour[g]	N/A[h]	2.1 mg/m³

Note: µg/m³ = micrograms per cubic meter; AAAQS = Alaska Air Quality Standards; CFR = Code of Federal Regulations; CO = carbon monoxide; mg/m³ = milligrams per cubic meter; NAAQS = National Ambient Air Quality Standards; NH_3 = ammonia ; NO_2 = nitrogen dioxide; N/A = not applicable; O_3 = ozone; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 microns; ppb = parts per billion; ppm = parts per million; SO_2 = sulfur dioxide

[a] The 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

[b] Annual mean.

[c] Not to be exceeded more than once per year on average, over a 3-year period.

[d] The 98th percentile of 24-hour average concentrations, averaged over 3 years.

[e] Annual mean, averaged over 3 years.

[f] The 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.

[g] Not to be exceeded more than once per year.

[h] Not applicable. EPA revoked the federal 24-hour and annual SO_2 standards on June 2, 2010 (75 FR 3520, June 22, 2010). EPA does not regulate NH_3 as a criteria air pollutant under the Clean Air Act.

[i] Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.

Emissions of criteria air pollutants were not estimated for the construction phase, because a construction plan and data are not available that would provide the parameters required for estimating emissions, such as methods of construction, quantity and types of equipment to be used, types and quantities of fuel to be used, and other criteria. To provide information useful for comparing potential air quality impacts among alternatives, emissions were estimated for the operational phase for each of the 3 alternatives (A, B, and C) for mining-related vehicle travel on the unpaved (gravel) Ambler Road and the added mining-related travel on the paved Dalton Highway to Fairbanks. This emissions assessment was performed for calendar year 2038, which is expected to be the first year with the highest activity level of mining-associated truck traffic. Because fleet-average exhaust emission factors are dropping with time, using the earliest year should give a worst-case estimate for exhaust emission factors.

Emission factors for the exhaust, crankcase, and fuel evaporative components were estimated using the EPA's MOVES model (version 14b). For particulate matter, the emissions from these components were added to the estimated emissions of re-suspended road dust, calculated using the equations of EPA Publication AP-42, Sections 13.2.1 (paved roads) and 13.2.2 (unpaved roads). Emission factors are summarized in Table 21.

Table 21. EPA's MOVES emission factors

Vehicle type	Vehicle type ID	Fuel type	Pollutant	Pollutant ID	Emission factor (grams/ vehicle-mile) (Jan)	Emission factor (grams/ vehicle-mile) (July)	Average
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	CO	2	6.60E-01	6.83E-01	6.72E-01
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	NO_X	3	3.87E-02	3.55E-02	3.71E-02
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	SO_2	31	1.57E-03	1.57E-03	1.57E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	VOC	87	2.07E-02	2.18E-02	2.13E-02
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	PM_{10} – Exhaust	100	2.65E-03	2.94E-03	2.80E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	PM_{10} – Brake wear	106	1.14E-02	1.14E-02	1.14E-02
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	PM_{10} – Tire wear	107	8.32E-03	8.32E-03	8.32E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	$PM_{2.5}$ – Exhaust	110	2.35E-03	2.61E-03	2.48E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	$PM_{2.5}$ – Brake wear	116	1.42E-03	1.42E-03	1.42E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	$PM_{2.5}$ – Tire wear	117	1.25E-03	1.25E-03	1.25E-03
Light-duty Truck	31	50%/50% Gasoline/Diesel Mix	CO_{2e}	98	2.34E+02	2.34E+02	2.34E+02
Combination Long-haul Truck	62	Diesel	CO	2	3.11E-01	3.11E-01	3.11E-01
Combination Long-haul Truck	62	Diesel	NO_X	3	1.26E+00	1.17E+00	1.21E+00
Combination Long-haul Truck	62	Diesel	SO_2	31	1.20E-02	1.20E-02	1.20E-02
Combination Long-haul Truck	62	Diesel	VOC	87	8.08E-02	8.08E-02	8.08E-02
Combination Long-haul Truck	62	Diesel	PM_{10} – Exhaust	100	2.62E-02	2.62E-02	2.62E-02
Combination Long-haul Truck	62	Diesel	PM_{10} – Brake wear	106	6.47E-02	6.47E-02	6.47E-02
Combination Long-haul Truck	62	Diesel	PM_{10} – Tire wear	107	2.98E-02	2.98E-02	2.98E-02
Combination Long-haul Truck	62	Diesel	$PM_{2.5}$ – Exhaust	110	2.41E-02	2.41E-02	2.41E-02

Vehicle type	Vehicle type ID	Fuel type	Pollutant	Pollutant ID	Emission factor (grams/ vehicle-mile) (Jan)	Emission factor (grams/ vehicle-mile) (July)	Average
Combination Long-haul Truck	62	Diesel	$PM_{2.5}$ – Brake wear	116	8.09E-03	8.09E-03	8.09E-03
Combination Long-haul Truck	62	Diesel	$PM_{2.5}$ – Tire wear	117	4.48E-03	4.48E-03	4.48E-03
Combination Long-haul Truck	62	Diesel	CO_{2e}	98	1.45E+03	1.45E+03	1.45E+03

Note: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; NO_x = oxides of nitrogen; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 microns; SO_2 = sulfur dioxide; VOC = volatile organic compound

The AP-42 inputs for unpaved roads in MOVES required the following assumptions and variables. For surface material silt content an amount of 4.8 percent (AP-42, Table 13.2.2-1 – Sand and Gravel Processing). The annual precipitation was taken from Equation 1a from Chapter 13.2.2 of AP-42 and precipitation adjustment factor applied (Equation 1a emission factor times [365 minus 90 days] divided by 365). The dust suppression control efficiency applied to the estimation was 50 percent, an accepted level of control efficiency by BLM. The particle size multipliers used in for unpaved roads estimations are 0.15 pound per vehicle mile traveled (lb/VMT) for $PM_{2.5}$ and 1.5 lb/VMT for PM_{10} as compared to 4.9 lb/VMT for total PM (AP-42, Chapter 13.2.2, Table 13.2.2-2).

The AP-42 inputs for paved roads in MOVES include the following assumptions and variables. For surface silt loading: 0.6 gram per meter squared (g/m^2) (Table 13.2.1-2, baseline x 3). This is a conservative winter-based silt loading from ADT category 500-5,000. For vehicles, an average weight of 12.5 tons was used, and was based on project-related mix of light and heavy trucks on the Dalton Road. The annual precipitation used was 90 wet days with at least 0.254 mm of precipitation during the 365 days in the averaging period (AP-42, Chapter 13.2.1, Equation 2). The AP-42 particle size multipliers used in paved road estimation are 0.00054 lb/VMT for $PM_{2.5}$ and 0.0022 lb/VMT for PM_{10} as compared to 0.011 lb/VMT for total PM (AP-42, Chapter 13.2.1, Table 13.2.1-1).

MOVES was executed in "national default" mode, selecting the Yukon-Koyukuk Borough for specification of appropriate climate data. While portions of the routes will extend into the Fairbanks North Star and Northwest Arctic boroughs, the Yukon-Koyukuk Borough would include the majority of the travel, and the climate data from this borough are considered generally representative of the various alternative routes.

Exhaust emission factors were generated by MOVES for 2 vehicle types for this study: combination long-haul trucks (i.e., semi-trucks, which are all diesel-fueled), and light-duty trucks. The light-duty trucks were assumed to be split evenly between gasoline and diesel-fueled trucks.

The MOVES emission factors were generated in units of grams per vehicle mile traveled (g/VMT), using an assumed vehicle speed of 50 miles per hour, and the emission factors for fugitive dust were generated in units of lb/VMT. These emission factors were then multiplied by the appropriate estimates of mining-related annual VMT for each alternative and vehicle type, considering the separate road types (paved and unpaved) for the fugitive PM_{10} and $PM_{2.5}$ emissions estimates. Table 22 reflects emissions for the trip distances along the Ambler Road alternatives, which are defined as the intersection with the Dalton Highway to the terminus at the Ambler River. These Ambler Road distances are 211 miles, 228 miles,

and 332 miles for Alternatives A, B, and C, respectively. Table 23 reflects emissions for the trip distances along the Dalton Highway, connecting to Fairbanks along the Elliott Highway. These distances, labeled Dalton Highway, are 245 miles for Alternatives A and B, and 144 miles for Alternative C. Table 24 reflects emissions along the total trip distances from the Ambler Mining District to Fairbanks. These distances are 456, 473, and 476 miles for Alternatives A, B, and C, respectively.

Table 22. Ambler Road operational phase estimated emissions (tons/year)

Pollutant/Process	Alternative A	Alternative B	Alternative C
CO	6.3	6.8	9.3
NO_x	18.2	19.5	26.0
SO_2	0.2	0.2	0.3
VOCs	1.3	1.4	1.8
PM_{10} Total (No Dust Control)	5,948.5	6,688.1	13,968.8
PM_{10} – Total (With Dust Control)	3,021.5	3,393.4	7,026.8
PM_{10} – Exhaust	0.4	0.4	0.6
PM_{10} – Brake wear	1.0	0.7	0.8
PM_{10} – Tire wear	0.5	0.3	0.4
PM_{10} – Fugitive (No Dust Control)	5,946.6	6,686.1	13,966.2
PM_{10} – Fugitive (With Dust Control)	3,019.7	3,391.4	7,024.2
$PM_{2.5}$ – Total (No Dust Control)	608.7	683.3	1,409.4
$PM_{2.5}$ – Total (With Dust Control)	316	353.8	715.2
$PM_{2.5}$ – Exhaust	0.4	0.4	0.5
$PM_{2.5}$ – Brake wear	0.1	0.1	0.2
$PM_{2.5}$ – Tire wear	0.1	0.1	0.1
$PM_{2.5}$ – Fugitive (No Dust Control)	608.2	683.7	1,408.6
$PM_{2.5}$ – Fugitive (With Dust Control)	315.5	353.2	714.4

Note: CO = carbon monoxide; NO_x = oxides of nitrogen; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 microns; SO_2 = sulfur dioxide; VOCs = volatile organic compounds

Table 23. Dalton Highway operational phase estimated emissions (tons/year)

Pollutant/Process	Alternative A	Alternative B	Alternative C
CO	7.4	7.4	4.0
NO_x	21.1	21.1	11.3
SO_2	0.2	0.2	0.1
VOCs	1.5	1.5	0.8
PM_{10} Total (No Dust Control)	7,186.8	7,186.8	6,058.8
PM_{10} – Total (With Dust Control)	3,645.4	3,646.4	3,047.8
PM_{10} – Exhaust	0.5	0.5	0.2
PM_{10} – Brake wear	1.2	1.2	0.6
PM_{10} – Tire wear	0.5	0.5	0.3
PM_{10} – Fugitive (No Dust Control)	3,644.2	3,644.2	3,046.6

Pollutant/Process	Alternative A	Alternative B	Alternative C
PM_{10} – Fugitive (With Dust Control)	457.8	457.8	336.7
$PM_{2.5}$ – Total (No Dust Control)	734.2	734.2	611.3
$PM_{2.5}$ – Total (With Dust Control)	366.9	380.2	310.2
$PM_{2.5}$ – Exhaust	0.4	0.4	0.2
$PM_{2.5}$ – Brake wear	0.1	0.1	0.1
$PM_{2.5}$ – Tire wear	0.1	0.1	0.0
$PM_{2.5}$ – Fugitive (No Dust Control)	733.6	733.6	610.9
$PM_{2.5}$ – Fugitive (With Dust Control)	379.5	379.5	309.8

Note: CO = carbon monoxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 microns; SO_2 = sulfur dioxide; VOC = volatile organic compounds

Table 24. Total operational phase estimated emissions (tons/year)

Pollutant/Process	Alternative A	Alternative B	Alternative C
CO	13.7	14.1	13.3
NO_x	39.3	40.5	37.2
SO_2	0.4	0.4	0.4
VOCs	2.7	2.8	2.6
PM_{10} Total (No Dust Control)	13,135.3	13,874.9	20,027.6
PM_{10} – Total (With Dust Control)	6,530	7,039.7	10,074.6
PM_{10} – Exhaust	0.9	0.9	0.8
PM_{10} – Brake wear	2.1	2.2	2.0
PM_{10} – Tire wear	1.0	1.0	1.0
PM_{10} – Fugitive (No Dust Control)	13,131.3	13,870.8	20,023.8
PM_{10} – Fugitive (With Dust Control)	6,526	7,035.6	10,070.8
$PM_{2.5}$ – Total (No Dust Control)	1,342.9	1,417.5	2,020.7
$PM_{2.5}$ – Total (With Dust Control)	681.7	732.7	1,024.2
$PM_{2.5}$ – Exhaust	0.8	0.8	0.7
$PM_{2.5}$ – Brake wear	0.3	0.3	0.3
$PM_{2.5}$ – Tire wear	0.2	0.2	0.1
$PM_{2.5}$ – Fugitive (No Dust Control)	1,341.7	1,416.2	2,109.5
$PM_{2.5}$ – Fugitive (With Dust Control)	681.7	732.7	1,024.2

Note: CO = carbon monoxide; PM_{10} = particulate matter with an aerodynamic diameter less than or equal to 10 microns; $PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 microns; SO_2 = sulfur dioxide; VOCs = volatile organic compounds

1.7.1 Greenhouse Gas Emissions*

Greenhouse gases (GHGs) are gaseous compounds in the atmosphere that can absorb infrared radiation and are effective at trapping and holding energy from the sun and heat in the atmosphere. GHGs are emitted by both natural and anthropogenic sources. The most common GHGs in the atmosphere are water vapor, carbon dioxide (CO_2) and methane (CH_4). Scientists have developed global warming potentials (GWP) for GHGs to provide a way to compare global warming impacts of these different gases. Each GHG has a GWP that accounts for the intensity of its heat trapping effect and its longevity in the

atmosphere. According to the Intergovernmental Panel on Climate Change (IPCC), GWPs typically have an uncertainty of ±35 percent. GWPs have been developed for several GHGs over different time horizons including 20-year, 100-year, and 500-year. The choice of emission metric and time horizon depends on type of application and policy context; hence, no single metric is optimal for all policy goals. The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol and is now used widely as the default metric. In addition, the EPA uses the 100-year time horizon in its Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017 (April 2019), GHG Reporting Rule requirements under 40 Code of Federal Regulations Part 98, Subpart A, and uses the GWPs and time horizon consistent with the IPCC Fifth Assessment Report in its science communications.

The GWP expresses how much energy 1 ton of a GHG emitted will absorb over a specific time period in comparison to 1 ton of CO_2 emitted. CO_2 is used as the comparison point, and it is given a GWP of 1. The other GHGs range in how they contribute to warming the earth's atmosphere and have a higher GWP compared to CO_2 over a time period. The GWP for CH_4 is 25 and for N_2O is 298. Emissions calculated using these GWPs are expressed as carbon dioxide equivalents (CO_2e).

GHG emissions were calculated for the construction phase under each alternative because emission factor data were available for estimating emissions of GHGs based on estimated material quantities, typical off-road construction equipment, and fuel used to move materials. The Federal Highway Administration fuel use factors in highway and bridge construction were used to identify additional fuel needs for vegetation clearing of forested and shrub areas, and the installation of bridges and culvert pipe structures. Further estimates were made to identify additional emissions associated with transportation of workers to/from the construction area, and electrical generation at construction camps. Estimated GHG emissions under each alternative do not include the transportation of materials to the construction area, or other fuel uses associated with the construction and operation of the construction camps, maintenance sites, communication sites, or airstrips. The estimates do not include the removal of the road at the end of the project life, but the removal effort may be reasonably assumed to be similar in scope as the construction emissions. The GHGs most likely to be emitted from the proposed project would be a result of fossil fuel combustion in vehicles, construction equipment and heat and power generation and include CO_2, CH_4, and nitrous oxide (N_2O). GHGs emitted as a result of the project contributions to accelerating local thawing of permafrost have not been included in these calculations. Current climate models include gradual thawing of permafrost, however abrupt thawing rates may increase GHG emission by up to 190 percent (Walter Anthony et al. 2018). Overall, current CH_4 emissions from melting permafrost are estimated at about 1 percent of global methane budget, but are anticipated to grow to be the second largest anthropogenic source of GHGs by mid-century (Walter Anthony et al. 2018; NASA 2018; Schaefer et al. 2014).The GHG emissions were calculated as CO_2e using EPA emission factors and the appropriate GWP. The resultant CO_2e emissions for the project are shown in Table 25 for comparison with GHG emissions on a local, state-wide, country-wide, or global level. Using the EPA GHG equivalency calculator (www.epa.gov/energy/greenhouse-gas-equivalencies-calculator) the Alternative A, CO_2e emissions are equivalent to an annual energy use of 11,439 homes, Alternative B to 12,812 homes, and Alternative C to 17,816 homes.

Table 25. Ambler Road construction phase GHG emissions (metric tons)

Emissions	Alternative A	Alternative B	Alternative C
Material estimates (cubic yards)	15 million	16.8 million	22 million
Off-road fuel (gallons)[a]	5.82 million	6.52 million	9.07 million
Total CO_2e (tons)[b]	**99,136**	**111,020**	**154,395**

Sources: GreenDOT Calculator (GHG Calculator for State Departments of Transportation, version 1.5 beta), Fuel Usage Factors in Highway and Bridge Construction (National Academies of Science 2013).

Note: CO_2e = carbon dioxide equivalent

[a] Operating plans for the construction of the project have either not been provided, or have not been developed. Off-road fuel estimates are diesel fuel volumes estimated for operation of typical construction equipment used in new road construction, addressing the movement of material fill, culvert installations, and bridge construction.

[b] Total CO_2e includes CO_2 equivalent calculations for the production and movement of construction soils, off-road construction vehicle usage, on-road transportation associated with the movement of workers to support construction, and electricity generation estimates for construction camps. This does not include emissions the operation of maintenance stations, emissions associated with annual maintenance activities through the anticipated life of the road, the construction and operation of any mines, or the emissions associated with the vehicle usage on the road (see Table 22 through Table 26).

Table 26 summarizes annual GHG emissions for the operational phase including transportation of mining ore from the Ambler Mining District to the Port of Alaska. These estimated emissions are based on traffic estimates developed as part of the mine development and production schedule scenario outlined in Appendix H. It uses the CO_2e calculated for the road transportation along each alternative to Fairbanks as well as the estimated rail emissions for the railroad cars needed to take the ore from Fairbanks to the Port of Alaska in Anchorage. Road transportation CO_2e emission estimates were calculated in the same way as criteria pollutants using the EPA's MOVES model (version 14b) and was based on miles on each segment of road for 2 vehicle types of combination long-haul trucks and light-duty trucks. The resultant CO_2e emission factors shown in Table 21 were then multiplied by the appropriate estimates of project-related annual VMT for each alternative and vehicle type. Rail assumptions included 2 weekly trains of 75 cars carrying loads of ore, returning with empty cars. Fuel efficiency factors were developed using Surface Transportation Board (STB) Annual 2018 Report for UP freight diesel fuel use.

Table 26. Annual cumulative GHG emissions from ore transportation, by alternative (CO_2e in metric tons/year)

Emission Type	Alternative A	Alternative B	Alternative C
Roadway Emissions	47,668	49,273	45,410
Ambler Road Segment	22,146	23,751	31,673
Dalton Highway to Fairbanks	25,522	25,522	13,738
Rail Emissions	6,562	6,562	6,562
Total Annual Emissions	54,230	55,835	51,972

Note: CO_2e is an expression of the total GHG emissions expressed as the equivalent of CO_2.

For perspective, in 2015, State of Alaska GHG emissions were estimated to be 39.54 million metric tons (MMT) per year (ADEC 2018), and national GHG emissions were 6,624 MMT per year (EPA 2019). Total surface transportation (on-road and rail) estimates were 2.88 MMT/year in Alaska in 2015. This project would add less than 2 percent to the Alaska surface transportation emissions inventory.

Social Cost of Greenhouse Gases

This section discusses the social cost of greenhouse gases (GHG). In accordance with management direction discussed in Chapter 3.2-7, Table 27 provides estimates of the monetary value of changes in GHG emissions that could result from future actions associated with the project. The SC-GHGs

associated with estimated emissions from construction and operations represent the present value of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions. Estimates are calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and estimates of emissions in each year. They are rounded to the nearest $1,000. These estimates assume development would start in 2025, and end-use emissions would be complete in 2074, based on a 50-year life.

SC-GHGs cannot be estimated for reasonably foreseeable actions (RFAs) presented in Appendix H (Indirect and Cumulative Scenarios), including but not limited to the reasonably foreseeable mine development scenario, due to a lack of details concerning anticipated equipment rosters, equipment and delivery trips, workforce, and stationary emission sources for the construction, operational, and reclamation phases of RFAs.

This analysis should not be construed to mean a cost determination is necessary to address potential impacts of GHGs. These numbers were monetized; however, they do not constitute a complete cost-benefit analysis, nor do the SC-GHG numbers present a direct comparison with other impacts analyzed in this document. SC-GHG is provided only as a useful measure of the benefits of GHG emissions reductions to inform agency decision making.

Table 27. Total SC-GHG (in 2020 dollars) associated with construction and operational emissions*

Alternative	Average Value, 5% Discount Rate	Average Value, 3% Discount Rate	Average Value, 2.5% Discount Rate	95th Percentile Value, 3% Discount Rate
Alternative A	$22,654,048	$98,962,248	$154,820,659	$302,786,576
Alternative B	$23,446,515	$102,336,347	$160,070,717	$313,094,715
Alternative C	$22,520,274	$97,795,777	$152,806,522	$299,116,019

Note: For federal agencies, the best currently available estimates of SC-GHG are the interim estimates of the social costs of CO_2, CH_4, and N_2O developed by the IWG. Select estimates are published in the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990* (IWG 2021) and the complete set of annual estimates are available on the U.S. Office of Management and Budget's website.

The IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are a less important factor in present-day decisions). The current set of interim estimates of SC-GHG have been developed using three different annual discount rates: 2.5%, 3%, and 5% (IWG 2021).

As expected with such a complex model, there are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021). To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

To further address uncertainty, the IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average damages from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95th percentile of damages estimated, applying a 3% annual discount rate for future economic effects. This is a low probability, but high damage scenario that represents an upper bound of damages within the 3% discount rate model. The estimates in this table follow the IWG recommendations.

2. References

ADEC (Alaska Department of Environmental Conservation), Division of Air Quality. 2018. Alaska Greenhouse Gas Emissions Inventory 1990-2015. January 2018.

ADEC. 2019. Contaminated sites, Alaska Department of Conservation. Available at: dec.alaska.gov/spar/csp.aspx.

ADNR (Alaska Department of Natural Resources). 2019. Alaska Mapper: Water Estate Map (public). Available at dnr.alaska.gov/mapper/. Accessed June 27, 2023.

BLM (Bureau of Land Management). 2016. Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands. IM 2016-124. July 8, 2016. Available at: www.blm.gov/sites/blm.gov/files/uploads/IM2016-124_att1.pdf. Accessed May 15, 2019.

Cardno. 2015. Ambler Mining Region Economic Impact Analysis. Prepared for AIDEA. January 16, 2015. Available at: www.aidea.org/Portals/0/PDF%20Files/CARDNOAmblerEconomicImpactAnalysis.pdf.

EPA (U.S. Environmental Protection Agency). 2019. National-Level U.S. Greenhouse gas Inventory 1990-2017. EPA 430-F-19-001, April 2019. Available at: www.epa.gov/sites/production/files/2019-04/documents/2019_fast_facts_508_0.pdf.

Ferrians, O.J. 1965. Permafrost map of Alaska - U.S. Geological Survey Miscellaneous Geologic Investigations Map I-445. Scale 1 to 2,500,000.

FHWA (Federal Highway Administration). 2006. *Construction Noise Handbook*. FHWA-HEP-06-015. Available at: www.fhwa.dot.gov/environment/noise/construction_noise/handbook/.

Kane, D.L., E.K. Youcha, S.L. Stuefer, H. Toniolo, J.W. Homan, W.E. Schnabel, R.E. Gieck, E. Lamb, T. Tschetter, and G. Myerchin-Tape. 2015. *Environmental Studies of Ambler Transportation Corridor, Alaska*. Final Report. University of Alaska Fairbanks, Water and Environmental Research Center, INE/WERC 15.14. Fairbanks, Alaska.

NASA (National Aeronautics and Space Administration). 2018. Unexpected future boost of methane possible from Arctic permafrost. NASA Global Climate website, NASA Jet Propulsion Laboratory. Available at: climate.nasa.gov/news/2785/unexpected-future-boost-of-methane-possible-from-arctic-permafrost/.

National Academies of Sciences, Engineering, and Medicine. 2013. Fuel Usage Factors in Highway and Bridge Construction. Exhibit S-1. The National Academies Press. Washington, D.C. Available at: doi.org/10.17226/22629.

NCEI (National Centers for Environmental Information) NOAA (National Oceanic and Atmospheric Administration. n.d. Climate Data Online. Climate records for Bettles, Coldfoot, Hogatza River, Kiana, and Selawik. Available at: www.ncdc.noaa.gov/cdo-web/datasets.

North of 360 Mining News. 2018. Alaska Geologists Enter Valhalla Minerals. September 2018. Available at: www.miningnewsnorth.com/story/2018/09/01/news/alaska-geologists-enter-valhalla-metals/5330.html.

Schaefer, K. H. Lantuit, V.E. Romanovsky, E.A.G. Schuur, and R. Witt. 2014. The impact of the permafrost carbon feedback on global climate. *Environmental Research Letters* 9(2014) 085003:1–9. Available at: iopscience.iop.org/article/10.1088/1748-9326/9/8/085003/pdf.

Solie, D.N., and J.E. Athey. 2015. Preliminary evaluation of bedrock potential for naturally occurring asbestos in Alaska: Alaska Division of Geological & Geophysical Surveys Miscellaneous Publication 157, 15 p., 21 sheets, scale 1:500,000. Available at: doi.org/10.14509/29447.

Trilogy Metals, Inc. 2017. Reserves and Resources. Available at: trilogymetals.com/. Accessed November 9, 2017.

USGS (U.S. Geological Survey). No date. Topographic and route alignment layers of Ambler Viewer.

USGS. n.d. USGS Scientific Investigations Map 3340, Geological Map of Alaska. GIS data accessed at: mrdata.usgs.gov/sim3340/.

USGS. 2019. National Water Information System: Web Interface. Data for sites 15564879 (Slate Creek at Coldfoot), 15743850 (Dahl Creek near Kobuk), 15453500 (Yukon Springs near Stevens Village), 15565885 (Jim River near Bettles), 15564900 (Koyukuk River at Hughes), and 15564875 (MT Koyukuk River near Wiseman). Available at: waterdata.usgs.gov/nwis/inventory.

Walter Anthony, K., T.S. von Deimling, I. Nitze, S. Frolking, A. Emond, R. Daanen, P. Anthony, P. Lindgren, B. Jones, and G. Grosse. 2018. 21st-century modeled permafrost carbon emissions accelerated by abrupt thaw beneath lakes. *Nature Communications* 9:3262. Available at: www.ncbi.nlm.nih.gov/pmc/articles/PMC6093858/.

Attachment A. Predictive Noise Modeling of the Ambler Road

Predictive Noise Modeling of the Ambler Road

Presenting acoustic models of potential noise from vehicle traffic alternatives on the Ambler Road using Cadna-A noise prediction software

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Predictive Noise Modeling of the Ambler Road

Purpose / Background

This document presents acoustic models of potential noise from vehicle traffic on the Ambler Road.

As such, it builds upon – and documents deviations from – the technique employed by Big Sky Acoustics in developing a noise model for the *Ambler Mining District Industrial Access Project Department of the Interior Permit Application Supplemental Narrative, Appendix 4-H: Ambler Mining District Industrial Access Road Environmental Sound Analysis*. For a full description of the basic assumptions of these models, please see the original documentation within the supplemental narrative. A basic overview of assumptions is as follows:

- Calculations by International Organization for Standardization (ISO) 9613-2 Attenuation of Sound during Propagation Outdoors, Part 2: General Method of Calculation.
- Vehicles assumed to operate over a 24-hour day at a certain hourly rate.
- Assumed speed limit of 45 miles per hour.
- Atmospheric conditions: 55° F, relative humidity 70 percent - mean conditions in Ambler, June through August 2014 (Weather Underground data)
- Ground factor assumed to be G = 1.0 (porous ground)

Due to the immense area influenced by the proposal, it was necessary to perform calculations over 11 separate study areas (Figure 1).

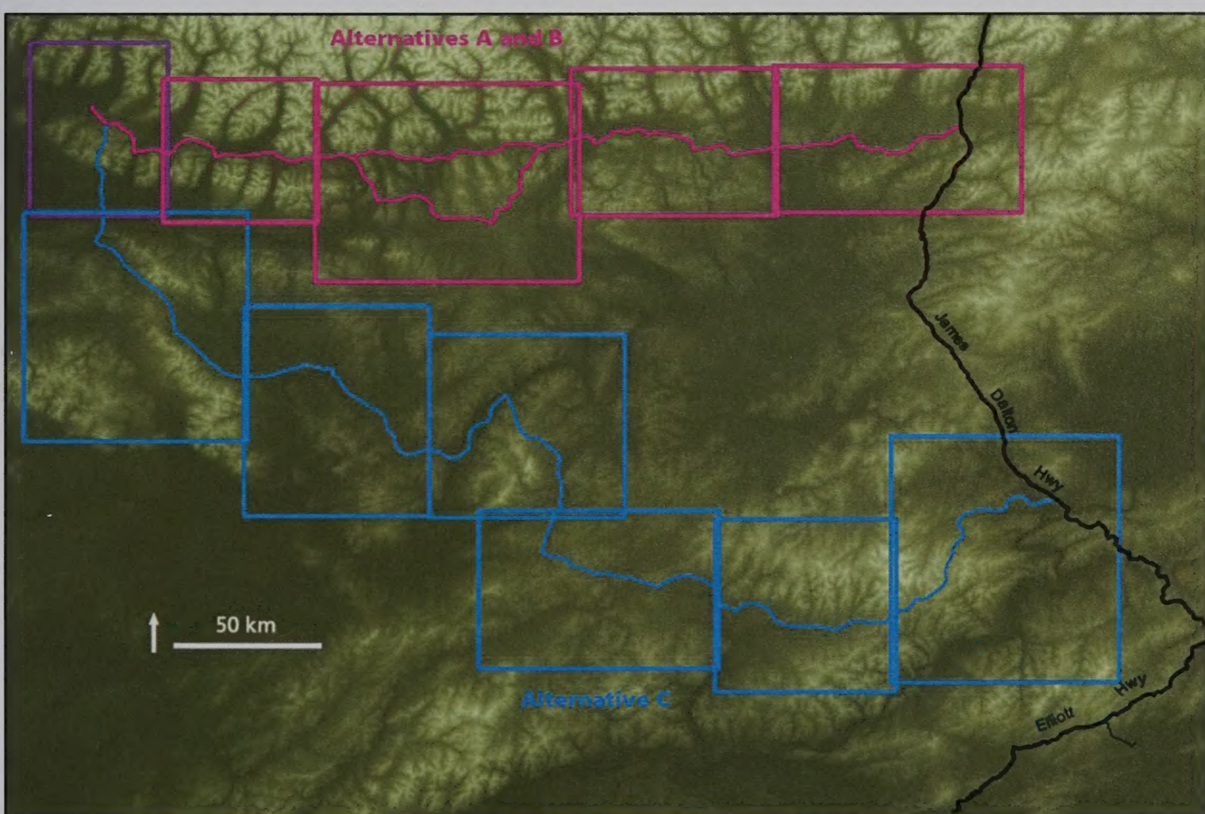

Figure 1. Overlapping study areas used to calculate the noise footprint of each alternative

Under the current development scenario that includes a single mine, the estimated volume of vehicles on the road is 6 heavy truck trips per hour[1].

Preparing Vehicle Line Sources

An initial challenge of the project was to develop line source information for traffic conditions using methodology of the Department of Transportation Traffic Noise Model. This approach was adopted for consistency with the original models included in the right of way application.

Curves showing broadband A-weighted sound pressure levels for heavy trucks as a function of vehicle speed are published in the FHWA Traffic Noise Model Technical Manual, Appendix A (*FHWA 1998, figures 8, 10, 12*). We used the heavy truck curve for at a speed of 45 miles per hour to model impacts of the proposed Ambler Road. Therefore if additional small vehicles are expected to use the road, these models will underestimate the impact of road development. If any vehicles travel faster than 45 miles per hour, these models will also underestimate impacts.

The 1/3rd octave band emission spectra for each vehicle type are published in the TNM Technical Manual, Appendix A (FHWA 1998, figures 17, 21, 26). These spectra are referenced to unity (0 dB,) so a numeric offset must be added such that the broadband level of the spectrum matches the broadband level of the vehicle travelling at a given speed. For heavy trucks travelling at 45 mph, the offset is 72.3 dB. Adjusted 1/3rd octave band levels are then summed to 1/1 octave band levels for the 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz bands. These provided the input for our modeling software, CadnaA (DataKustik).

Description of Results

Running each CadnaA scenario results in a 100x100 meter grid of 1-hour equivalent sound pressure levels ($LA_{eq,\ 1hr}$). Data from each study area were merged into complete road sections for each Alternative. Minor artifacts arising from the study area boundaries are visible in the results, but they do not affect estimates of impact to a meaningful degree.

All models presented below are clipped to an $LA_{eq,\ 1hr}$ of 16 dB. This level represents the 10th percentile sound pressure level (LA_{90}) in the area during the summer months (Betchkal 2019) or median natural conditions (LA_{50}) during the Alaskan winter months (Betchkal 2013, NPS 2013). In other words, the natural conditions that would limit a person or animal's ability to hear truck noise at distance. For alternatives that affect Gates of the Arctic National Park and Preserve, such an analysis threshold is consistent with NPS management policy §8.2.3 (NPS 2006), which states that the natural ambient sound level is the baseline against which impacts of proposed actions should be evaluated.

[1] Vehicle count determined through consultation with John McPherson, HDR, Inc. on 05/14/19.

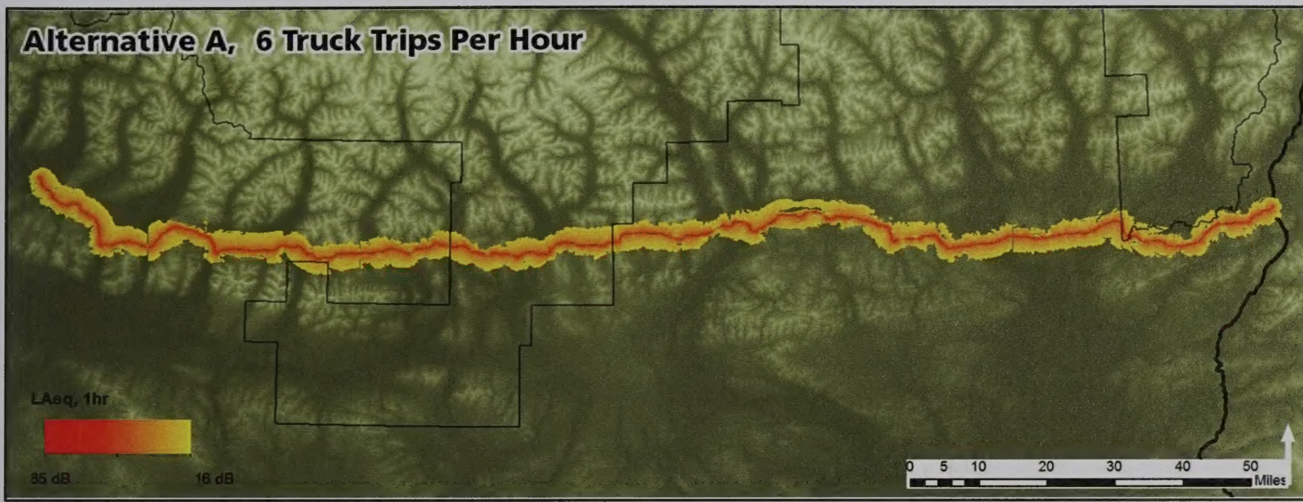

Figure 2. Modeled LA_{eq}, 1hr for Alternative A given 6 truck trips per hour at 45 mph. Data are clipped to an ambient LA90 of 16 dB.

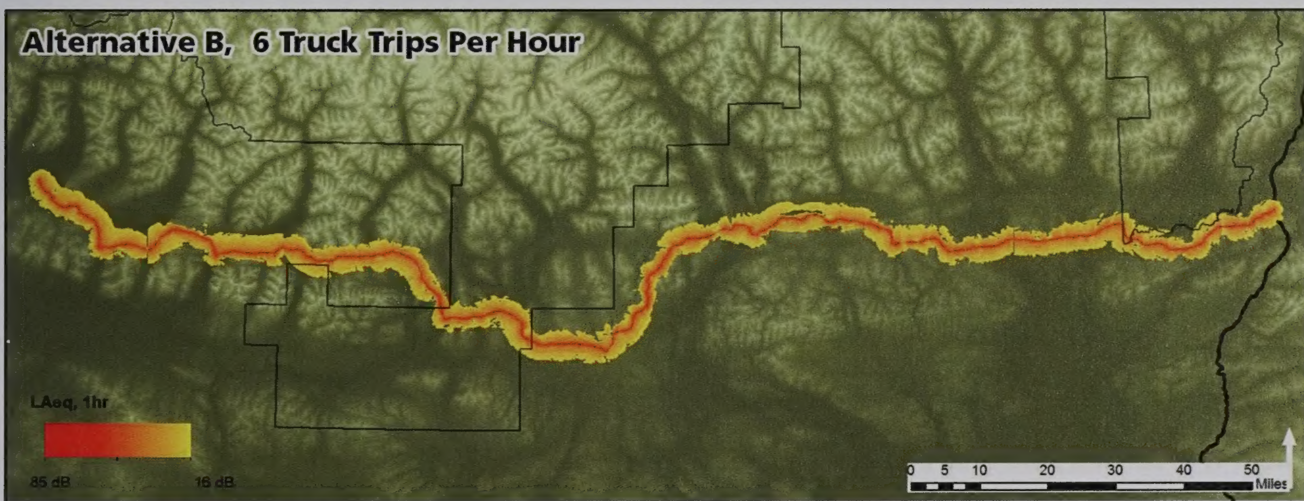

Figure 3. Modeled LA_{eq}, 1hr for Alternative B given 6 truck trips per hour at 45 mph. Data are clipped to an ambient LA90 of 16 dB.

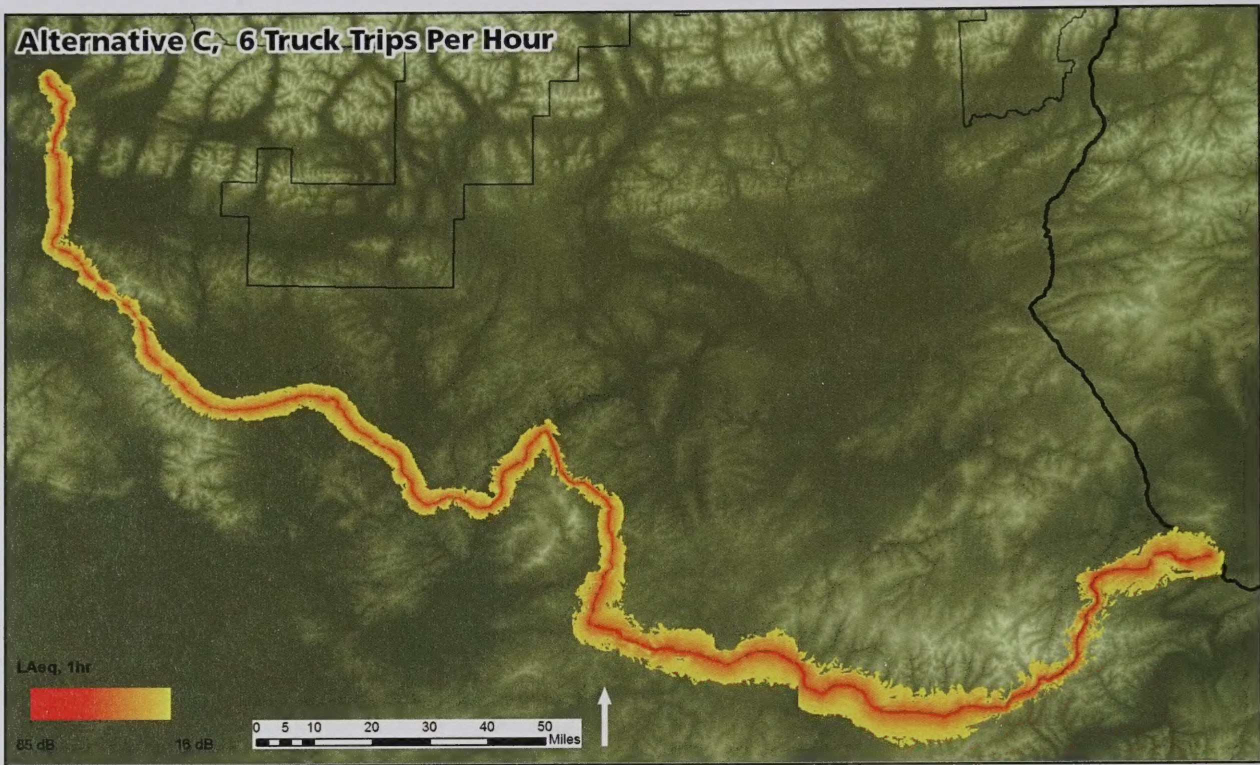

Figure 4. Modeled LA_{eq}, 1hr for Alternative C given 6 truck trips per hour at 45 mph. Data are clipped to an ambient LA90 of 16 dB.

Table 1 presents several numeric metrics of impact for each alternative. The first is the absolute area of land affected. The second is the area of land affected *per unit road length*, which attempts to illustrate how terrain differences between routes geographically restrict the impacts of noise.

Table 1. Predicted land area impacted by noise for each alternative and traffic scenario

Alternative	A	B	C
Area affected (mi^2)	788 mi^2	841 mi^2	1,681 mi^2
Area affected per unit road length (mi^2/mi)	3.7 mi^2/mi	3.7 mi^2/mi	5.1 mi^2/mi

Under any scenario a large area of land will be affected by noise. However, Alternative C will affect more previously undisturbed land in Alaska than Alternatives A and B. By comparison, the difference in impact between Alternatives A and B is relatively small.

The context of noise influences how appropriate it is in a certain place (Bijsterveld 2008, pg. 240). Alternative A represents a noise incursion into Gates of the Arctic National Park, and is predicted to impact federally-designated wilderness and a national natural landmark. Noise from Alternative C is predicted to be audible in several rural Alaskan communities.

Temporal Noise Impacts (Wildlife Crossing)

Noise is 1 of the contributing factors that causes roads to act as barriers to wildlife movement (Barber et al. 2010, Vistnes and Nellemann 2008, McClure et al. 2013). Gaps in time without noise – called *noise free intervals* – are expected to help encourage animal movement. Previous sections of this document

describe the *amplitude* impacts (i.e., the sound pressure level) of traffic on the road. Because the models shown above average over a 24-hour period, a complimentary analysis considers *temporal* impacts in their own right.

The alternatives all consider the same number of vehicles operating on the road, and so all are quite similar in terms of temporal impact. Without knowledge of vehicle spacing, the anticipated average noise free interval is ≤ 9.9 minutes, estimated using the following equation:

$$I_{avg} = \frac{1440\ minutes}{\left(6\ \frac{trucks}{hour}\ 24\ hours\right) + 1} = 9.9\ \frac{minutes}{truck}$$

However, the alternatives do differ in road length – and thus in traffic density. Density has a small effect on the length of noise free intervals observed. Thus Alternative C, being longer than A or B, will also provide slightly better opportunities for wildlife movement.

The speed limit of the road is the secondary factor that influences the length of noise free intervals. Lower speed limits will increase the median (i.e., typical) length of noise free interval, while higher speed limits will decrease the median noise free interval. In other words, lower speed limits provide more opportunity for animals to cross the road.

Literature Cited

Barber, J.R., Crooks, K.R., and Fristrup, K.M., 2010. The costs of chronic noise exposure for terrestrial organisms. *Trends in ecology & evolution,* 25(3), pp.180-189.

Betchkal, D. 2013. Acoustic monitoring report, Denali National Park and Preserve – 2012. Natural Resource Data Series. NPS/DENA/NRDS—2013/589. National Park Service. Fort Collins, Colorado.

Betchkal, D. 2019. Gates of the Arctic National Park and Preserve – acoustic inventory report, 2013 and 2014. Natural Resource Report NPS/GAAR/NRR—2019/1892. National Park Service, Fort Collins, Colorado. Natural Resource Report. NPS/GAAR/NRR—2019/1892. National Park Service. Fort Collins, Colorado.

Bijsterveld, K., 2008. Mechanical sound. *Technology, Culture, and Public Problems of Noise in the Twentieth Century*, pg. 240.

Department of Transportation, Federal Highway Administration (FHWA). 1998. FHWA Traffic Noise Model® Technical Manual. U.S. Dept. of Transportation, Federal Highway Administration, Washington, DC. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/tech_manual/TNM10TechManual.pdf

McClure, C.J., Ware, H.E., Carlisle, J., Kaltenecker, G. and Barber, J.R. 2013. An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. Proceedings of the Royal Society B: Biological Sciences, 280(1773), p.20132290.

National Park Service (NPS). 2006. Management Policies 2006. U.S. Department of the Interior, National Park Service, Washington, DC.

National Park Service (NPS). 2013. Winter Road Plowing in Denali National Park EA, Appendix D: Soundscape Information. pp. 78-79. Denali Park, Alaska.

Penland, C., 1988. The distribution of random segment lengths. *Geophysical Research Letters* 15(12), pp.1405-1408.

State of Alaska. 2015b. Ambler Mining District Industrial Access Project - Department of the Interior Permit Application Supplemental Narrative, Appendix 4-H: Ambler Mining District Industrial Access Road Environmental Sound Analysis. State of Alaska, Alaska Industrial Development and Export Authority, Anchorage, AK.

Vistnes, I. and Nellemann, C. 2008. The matter of spatial and temporal scales: a review of reindeer and caribou response to human activity. *Polar Biology* 31(4), pp.399-407.

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1. Affected Environment and Environmental Consequences – Biological Resources

1.1. Vegetation and Wetlands*

1.1.1 Affected Environment

Vegetation

Table 1 describes affected ecoregions in the project area (see also Volume 4, Maps, Map 3-7).

Table 1. Ecoregions and descriptions

Ecoregion	Description
Brooks Range	This east-west range is the northernmost extension of the Rocky Mountains and includes the Brooks Range, British Mountains, and Richardson Mountains. Many of the mountains are comprised of steep, angular summits flanked by rubble and scree. On the western and eastern ends of the range, the topography becomes less rugged. Rivers and streams cut narrow ravines into the terrain. During the Pleistocene, glaciers covered the higher portions of the range. Only a few small cirque glaciers remain. A dry, polar climate dominates the land. Winters are long and cold, and summers are short and cool. Air temperatures decrease rapidly with increased elevation. Permafrost is mostly continuous south of the ridge crest. Dominant vegetation classes on the south side of the range are sedge tussocks and shrubs in valleys and lower slopes, sparse conifer-birch forests in large valleys, and alpine tundra and barrens at higher elevations. The ecoregion provides habitat for Dall sheep, caribou, marmots, gray wolves, and brown bears. Groundwater fed springs and streams provide habitat for Arctic grayling and Dolly Varden.
Kobuk Ridges and Valleys	The Kobuk ridges and valleys ecoregion is comprised of a series of paralleling ridges and valleys that radiate south from the Brooks Range, created partially by high-angle reverse faults and interceding troughs. In the past, ice sheets descending from the north covered the area. Alluvial and glacial sediments cover the broad valleys, while rubble covers the intervening ridges. The climate is dry continental with long, cold winters and short, cool summers. During winter, cold air drains from the Brooks Range into the valleys. Permafrost is thin to moderately thick throughout much of the area. Forests and woodlands dominate much of the area. Trees become increasingly sparse in the west. Tall and short shrub communities of birch, willow, and alder occupy ridges.
Ray Mountains	The Ray Mountains are comprised of compact, east-west oriented ranges. Rubble covers the metamorphic bedrock, and soils are shallow and rocky. During the Pleistocene, the Ray Mountains remained largely unglaciated. The climate is continental with dry, cold winters and somewhat moist, warm summers. Permafrost is discontinuous and ranges from thin to moderately thick. Dominant vegetation classes are black spruce woodlands; white spruce, birch, and aspen on south-facing slopes; white spruce, balsam poplar, alder, and willows on floodplains; and shrub birch and Dryas-lichen tundra at higher elevations. Clear headwater streams are important habitat for Arctic grayling. Moose, brown bears, gray wolves, red fox, lynx, and marten are common.

Source: Excerpted from Nowacki et al. 2001
Note: Only affected ecoregions are described.

Table 2 describes the vegetation types that occur in the project area (see also Volume 4, Map 3-8).

Table 2. Vegetation types and descriptions

Vegetation type	Description
Alpine and Arctic Tussock Tundra	Generally composed of tussock-forming sedges, often in combination with dwarf and low shrubs. Tussock cottongrass (*Eriophorum vaginatum)* is often the dominant sedge species. Shrubs tend to provide at least 25% cover and include ericaceous, willow (*Salix* spp.), and birch (*Betula* spp.) species. Herbaceous cover and diversity are low and often includes bluejoint grass (*Calamagrostis* spp.).
Alpine Dwarf Shrub Tundra	Widespread above the tree line on ridges, summits, side slopes, late-lying snow beds, and high elevation valleys. Plant species and vegetation community diversity is high. Vegetation is usually composed of dwarf evergreen or deciduous shrubs and may also include grasses, sedges, and lichen.
Upland Low and Tall Shrub	Dominates the landscape above the tree line, but below alpine dwarf shrubs on sites with deep active layers and well-drained soils, such as riparian zones and side slopes. The low shrub tundra type generally occurs above the tree line, dominated by birch and low willow species. Tall shrub thickets are often composed of alder (*Alnus* spp.) and willow species and occur on side slopes, drainages, and avalanche terrain.
Upland Mesic Spruce Forest	Often occurs near elevational tree line. Generally characterized by woodland and open forest canopies with a well-developed dwarf and low shrub understory. White spruce is often the dominant conifer. The shrub layer is typically composed of bog blueberry (*Vaccinium uliginosum)*, Labrador tea (*Rhododendron* spp.), tealeaf willow (*Salix pulchra),* and birch species. Feathermoss groundcover is common.
Upland Mesic Spruce Hardwood Forest	Generally occurs on well-drained slopes on eastern, southern, or western aspects. Forest composition comprises all post-fire seral stages, including conifer, deciduous, or mixed forest. Dominant species include white spruce, Alaska birch *(Betula neoalaskaana)*, and trembling aspen (*Populus tremuloides)*. A variety of shrub species, such as green alder (*Alnus viridis)*, resin birch (*Betula glandulosa),* and Labrador tea species, commonly occur. The herbaceous cover and species diversity is low.
Riparian Forest and Shrub	Occurs where fluvial processes are the major disturbance and includes a mix of successional stages linked to flooding frequency. Balsam poplar *(Populus balsamifera)* is the dominant deciduous tree and white spruce (*Picea glauca)* may be co-dominant or dominant. Alder or willow species usually dominate the shrub canopy. The herbaceous layer composition is diverse and varies by substrate type and successional stage.
Lowland Woody Wetland	Occurs on gently sloping to flat lowland terrain. Generally composed of coniferous wetlands and associated sedge-shrub bogs and fens that form mosaics of forested and non-forested wetland habitats. Dominant vegetation may include black spruce (*Picea mariana),* sedges (*Carex* spp.), cottongrass, and ericaceous and birch species.

Source: Boucher et al. 2016 in Trammell et al. 2016
Note: Descriptions do not include unvegetated barren landcover or open water.

Table 3 lists the percentages of each vegetation type within Study Areas A, B, and C.

Table 3. Percentage of vegetation types that occur within the extent of Volume 4, Map 3-8

Vegetation type	Percent of assessment area (%)
Alpine Arctic Tussock Tundra	5.7
Alpine Dwarf Shrub Tundra	14.5
Upland Low and Tall Shrub	29
Upland Mesic Spruce Forest	22
Upland Mesic Spruce Hardwood Forest	7

Vegetation type	Percent of assessment area (%)
Riparian Forest and Shrub	5.3
Lowland Woody Wetland	4.5
Emergent Herbaceous Wetlands	0.3
Grassland/Herbaceous	0.4
Sedge/Herbaceous	0.9
Moss	<0.1
Barren Land	1.9
Developed	<0.1
Perennial Ice/Snow	<0.1
Open Water	1.3
Unmapped	7.1[a]
Total assessment area	**100.0**

Source: Boucher et al. 2016 in Trammell et al. 2016

[a] Unmapped area occurs well outside of the area that would be affected by the project.

Wetlands

Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (USACE 1987). Wetlands are areas that are covered by water or have waterlogged soils for long periods during the growing season. Plants growing in wetlands are capable of living in saturated soil conditions for at least part of the growing season.

Waters of the U.S. (WOTUS) is a legal term stemming from the adoption of the Clean Water Act (CWA) in 1972. Wetlands are a subset of WOTUS and must possess the following: (1) a vegetation community dominated by plant species, typically adapted for life in saturated soils; (2) inundation or saturation of the soil during the growing season; and (3) soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions (USACE 1987, 2007). WOTUS and which wetlands are jurisdictional under the CWA have been the subject of repeated litigation.

On March 20, 2023, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers' (USACE) "Revised Definition of 'Waters of the U.S.'" rule (88 FR 3004) took effect. However, this revised definition of WOTUS was halted on May 25, 2023, when the U.S. Supreme Court published its decision in *Sackett v. Environmental Protection Agency*. This decision limits the application of the CWA to wetlands to those that have a direct surface connection to another body of federally protected water (i.e., a traditionally navigable waterway).

The EPA and USACE are currently developing a new rule to amend the final "Revised Definition of 'Waters of the United States'" rule based on the U.S. Supreme Court's decision in *Sackett v. Environmental Protection Agency*. The new rule will provide guidance on what wetlands and WOTUS are subject to the USACE's jurisdiction. The new rule is anticipated to be published by September 1, 2023.

The U.S. Supreme Court's decision in *Sackett v. Environmental Protection Agency* limits the jurisdiction of federal agencies to regulate activities in some wetlands, but it does not change the ecological definition of wetlands. Wetlands are analyzed in this Supplemental EIS based on their ecological definition, including all identified impacts under the action alternatives, and the impacted quantities may differ in the

project's USACE Section 404 permit as only those wetlands that meet jurisdictional requirements would be identified.

Table 4 and Table 5 describe the wetland and waterbody types found in the study areas (see also Volume 4, Map 3-9). Table 5 lists the Alaska Center for Conservation Science (ACCS) wetland types that occur within the extent of Volume 4, Map 3-9, and their extent.

Table 4. Description of wetland and waterbody types in the study areas

Aggregated wetland and waterbody types	Fine-scale wetlands and waterbody types within aggregated classes	Description
Palustrine forested (PFO; freshwater forested/shrub wetland)	PFO1, PFO1/4, PFO1/SS1, PFO4, PFO4/1, PFO4/SS1, PFO4/SS4	Vegetated wetlands characterized by woody plants that are 20 feet tall or taller and exceeding 25% cover. Functions may include nutrient and toxicant removal, general habitat suitability, and native plant species richness.
Palustrine scrub-shrub (PSS; freshwater/shrub wetland)	PSS1, PSS1/3, PSS1/4, PSS3, PSS4, PSS4/1, PSS1/EM1, PSS4/EM1, PSS1/FO4	Vegetated wetlands dominated by woody vegetation less than 20 feet tall. Species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted because of environmental conditions. Functions may include flood flow alteration, nutrient and toxicant removal, and general habitat suitability.
Palustrine emergent (PEM; freshwater emergent wetland)	PEM1, PEM1/SS1	Vegetated wetlands characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Perennial plants usually dominate these wetlands. Functions may include flood flow alteration, nutrient and toxicant removal, erosion control, shoreline stabilization, and general habitat suitability.
Palustrine moss-lichen (PML; freshwater bryophyte)	PML	Vegetated wetlands that include areas where mosses or lichens cover substrates other than rock and where emergent, shrubs, or trees make up less than 30% of the areal cover.
Palustrine waterbody (PUB; freshwater pond)	PUB	Generally characterized as waterbodies (ponds) less than 20 acres in size, lacking active wave-formed or bedrock shoreline features no deeper than 6.6 feet, and salinity less than 0.5 ppt. Functions may include sediment removal, nutrient and toxicant removal, erosion control, shoreline stabilization, and general habitat suitability.
Lacustrine waterbody (LUB; lake or deep pond)	L1UB, L2UB	Generally characterized as wetlands and deepwater habitats (lake or deep pond) with the following characteristics: situated in a topographic depression or a dammed river channel; lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with 30% or greater areal coverage; total area of at least 20 acres; and salinity less than 0.5 ppt.
Riverine (RUB)	R2UBH, R3UBH	Generally includes all wetlands and deepwater habitats that are contained within a channel, with the following exceptions: wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens; and habitats with water containing ocean-derived salts of 0.5 ppt or greater.

Sources: ACCS 2019a; Cowardin et al. 1979; DOWL 2014
Note: ppt = parts per thousand

Table 5. ACCS wetland types that occur within the extent of Volume 4, Map 3-9

ACCS wetland type	Percent of assessment area (%)[a]
PML	0.1
PEM	1.7
PFO/PSS	10.1
Total freshwater wetlands	**11.9**
PUB	0.3
LUB	0.8
RUB	0.9
Total waterbodies	**2.0**
Total wetland and waterbodies	**13.8**
Upland	86.2
Total assessment area	**100.0**

Source: ACCS 2019a
Note: ACCS = Alaska Center for Conservation Science
[a] Percent rounded to nearest 0.10.

The analysis used coarse-scale ACCS wetland mapping (ACCS 2019a) to provide broad context (see Volume 4, Map 3-09) and finer-scale (1 inch equals 1,000 feet or less) wetland mapping, and to assess specific wetland types. DOWL (2014) prepared field-verified mapping, for Alternatives A and B, apart from the eastern 50 miles of the two alignments. Field-verified mapping was not available for Alternative C. DOWL (2019) also prepared coarser-scale (1 inch equals 1,000 feet) desktop mapping, which was used where field-verified mapping was unavailable. This analysis mapped wetland types using the National Wetlands Inventory (NWI) classification system (Cowardin et al. 1979). For a description of field efforts and mapping methods, see DOWL (2014). Also see DOWL (2012, 2014, 2016) and ABR (2017) for reports on wetlands associated with the project.

Wetland delineation mapping conducted by DOWL in 2014 was completed using ArcMap GIS; a geo-referenced aerial photograph from 2012 was used as a base to digitally map wetlands, vegetation community boundaries, and riverine habitats and to then calculate habitat size. Final mapping was based on aerial photograph interpretation, site photographs, Light Detection and Ranging (LiDAR) 2-foot contours, and 1:24,000 scale hydrologic stream data. Field data was used to ground truth aerial photograph interpretations of preliminarily mapped communities. Polygons were coded as wetland or upland and provided Cowardin and Alaska Vegetation Classifications.

Wetland delineation mapping conducted by DOWL in 2019 was completed using publicly available aerial imagery services to delineate habitat types based on landscape position, water sources, vegetation structure, and topography. Creation of habitat boundary polygons used a scale of 1 inch = 1,000 feet. Minimum mapped polygon size was approximately of 0.25 acre. Other resources used for aerial interpretation of wetlands included National Wetland Inventory maps and United States Geological Survey (USGS) National Hydrography Dataset. The best available imagery from multiple publicly available sources, including ESRI World Imagery, Bing, and Alaska Department of Natural Resources, were used for delineation purposes. Polygons were coded as wetland or upland and provided Cowardin and Alaska Vegetation Classifications.

Table 6 lists the rare plants in the project area (see also Volume 4, Map 3-10).

Table 6. Rare plants in the project area*

Common name	Scientific name	State rank	Global rank	BLM[a]
Alaska moonwort	*Botrychium alaskense*	S3	G4	Watch List
Drummond's rockcress	*Boechera stricta*	SU	G5	N/A
False melic	*Schizachne purpurascens*	S2	G5	N/A
Fragile rockbrake	*Cryptogramma stelleri*	S3/S4	G5	N/A
Glacier buttercup	*Ranunculus camissonis*	S3	GNR	Watch list
Hudson Bay sedge	*Carex heleonastes*	S3	G4	N/A
Kokrine's locoweed	*Oxytropis kokrinensis*	S3	G3	Sensitive
Lapland Sedge	*Carex lapponica*	S3/S4	G4/G5Q	N/A
Longstem sandwort	*Arenaria longipedunculata*	S3/S4	G3/G4Q	Watch list
MacKenzie Valley mannagrass	*Glyceria pulchella*	S3/S4	G5	N/A
Northern sedge	*Carex deflexa* var. *deflexa*	S2/S3	G5	Watch list
Rock stitchwort	*Minuartia dawsonensis*	S3S4	G5	N/A
Selkirk's violet	*Viola selkirkii*	S3/S4	G5?	N/A
Siberian polypody	*Polypodium sibiricum*	S3	G5?	N/A
Small-leaf bittercress	*Cardamine microphylla*	S3/S4	G3/G4	Watch list
Thinleaf cottonsedge	*Eriophorum viridicarinatum*	S2/S3	G5	N/A
Umbrella starwort	*Stellaria umbellata*	S3/S4	G5	N/A
Woods' rose	*Rosa woodsii* ssp. *woodsii*	S2/S3	G5/T5	Watch list
Yellow lady's slipper	*Cypripedium parviflorum* var. *exiliens*	S2/S3	G5	Watch list
Yukon aster	*Symphyotrichum yukonense*	S3	G3	Sensitive

Source: ACCS, UAA 2023; BLM 2019
Note: BLM = Bureau of Land Management; N/A = not applicable. Search area was a 50-mile corridor surrounding all action alternatives,
[a] BLM (2019) Special Status Species list is updated every 3 years and therefore subject to change.

Non-native and Invasive Plants

Executive Order (EO) 13112 and 64 CFR 6183 define non-native plant species as species that are alien to a particular ecosystem; EO 13112 and 64 CFR 6183 define invasive species as non-native species whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. Table 7 lists the invasive, non-native plant species recorded within or near the study areas, including their invasiveness potential and legal status (see also Volume 4, Map 3-11).

Table 7. Invasive non-native plant species recorded within the vicinity of the project area

Common name	Scientific name	Invasiveness rank[a]	Invasiveness category[a]	Legal status[b]
Alfalfa	*Medicago sativa L.* ssp. *sativa*	59	Modestly Invasive	None
Alsike clover	*Trifolium hybridum L.*	57	Modestly Invasive	None

Common name	Scientific name	Invasiveness rank[a]	Invasiveness category[a]	Legal status[b]
Bird vetch	*Vicia cracca L. ssp. cracca*	73	Highly Invasive	Restricted
Bird's-foot trefoil	*Lotus corniculatus L.*	65	Moderately Invasive	None
Blue lettuce	*Lactuca tataricav (L.) C.A. Mey.*	Not ranked	Not ranked	None
Butter and eggs	*Linaria vulgaris P. Mill.*	69	Moderately Invasive	Restricted
Charlock mustard	*Sinapis arvensis L.*	Not ranked	Not ranked	None
Common dandelion	*Taraxacum officinale F.H. Wigg.*	58	Modestly Invasive	None
Common pepperweed	*Lepidium densiflorum Schrad.*	25	Very Weakly Invasive	None
Common plantain	*Plantago major L.*	44	Weakly Invasive	None
Common tansy	*Tanacetum vulgare L.*	60	Moderately Invasive	None
European bird cherry	*Prunus padus L.*	74	Highly Invasive	None
Foxtail barley	*Hordeum jubatum L.*	63	Moderately Invasive	None
Herb Sophia	*Descurainia sophia (L.) Webb ex Prantl*	41	Weakly Invasive	None
Icelandic poppy	*Papaver croceum Ledeb.*	39	Very Weakly Invasive	None
Italian tyegrass	*Lolium multiflorum Lam.*	41	Weakly Invasive	None
Lambsquarters	*Chenopodium album L.*	37	Very Weakly Invasive	None
Lupine clover	*Trifolium lupinaster L.*	Not ranked	Not ranked	None
Meadow foxtail	*Alopecurus pratensis L.*	52	Modestly Invasive	None
Narrowleaf hawksbeard	*Crepis tectorum L.*	56	Modestly Invasive	None
Narrowleaf hawkweed	*Hieracium umbellatum L.*	51	Modestly Invasive	None
Orange hawkweed	*Hieracium aurantiacum L.*	79	Highly Invasive	Prohibited
Oxeye daisy	*Leucanthemum vulgare Lam.*	61	Moderately Invasive	None
Pineappleweed	*Matricaria discoidea DC.*	32	Very Weakly Invasive	None
Prostrate knotweed	*Polygonum aviculare L.*	45	Weakly Invasive	None
Quackgrass	*Elymus repens (L.) Gould*	59	Modestly Invasive	Prohibited
Red sandspurry	*Spergularia rubra (L.) J.& K. Presl.*	34	Very Weakly Invasive	None
Shepherd's purse	*Capsella bursa-pastoris (L.) Medik.*	40	Weakly Invasive	None
Siberian peashrub	*Caragana arborescens Lam.*	74	Highly Invasive	None
Smooth brome	*Bromus inermis Leyss.*	62	Moderately Invasive	None

Common name	Scientific name	Invasiveness rank[a]	Invasiveness category[a]	Legal status[b]
Spreading bluegrass or Kentucky bluegrass	*Poa pratensis L. ssp. irrigata (Lindm.) H. Lindb. or Poa pratensis L. ssp. pratensis*	52	Modestly Invasive	None
White sweetclover	*Melilotus albus Medik.*	81	Extremely Invasive	None

Sources: ADNR 2019; ANHP 2019; Carlson et al. 2008; Trammell et al. 2016

[a] Invasiveness category is based on invasiveness rank scores, which were developed based on total scores from 21 assessment questions used by Carlson et al. (2008). Scores > 80 = "Extremely Invasive;" 70–79 = "Highly Invasive;" 60–69 = "Moderately Invasive;" 50–59 = "Modestly Invasive;" 40–49 = Weakly Invasive;" < 40 = "Very Weakly Invasive"

[b] Restricted species are generally considered nuisances or economically detrimental but can be controlled more easily.

1.1.2 Environmental Consequences

Vegetation

Impacts to vegetation were analyzed using the cut and fill footprint and a 10-foot temporary construction zone surrounding the cut and fill footprint. Impacts outside of the construction zones were assessed using a 328-foot (100-meter) buffer off the edge of the road, based on impacts from fugitive dust.

Impacts were calculated by overlaying the construction daylight limits and associated 10-foot and 328-foot (100-meter) buffers onto the Central Yukon Rapid Ecological Assessment (REA) vegetation mapping in GIS to quantify acres of each vegetation type that will be impacted. Table 8, Table 9, and Table 10 provide acreages of impacts to vegetation types within the construction footprint, the 10-foot temporary construction zone, and a 328-foot (100-meter) buffer surrounding the footprint. For all action alternatives, the project would be constructed in three phases. The Phase 3 construction footprint was used as the basis for this analysis, as it encompasses both Phase 1 and Phase 2 construction footprints.

Table 8. Alternative A vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland low and tall shrub	258.5	42.3	1,897.6	41.9	7,466.5	41.7
Upland mesic spruce forest	213.8	35.0	1,336.8	29.5	6,308.5	35.3
Upland mesic spruce-hardwood forest	38.5	6.3	218.2	4.8	1,106.0	6.2
Lowland woody wetland	24.0	3.9	215.8	4.8	683.9	3.8
Grassland/herbaceous	20.9	3.4	230.6	5.1	592.9	3.3
Alpine and arctic tussock tundra	18.1	3.0	130.8	2.9	495.0	2.8
Alpine dwarf shrub tundra	15.7	2.6	235.0	5.2	488.1	2.7
Riparian forest and shrub	13.4	2.2	115.5	2.6	382.9	2.1
Sedge/herbaceous	6.6	1.1	136.6	3.0	200.4	1.1
Open water	2.0	0.3	6.7	0.1	162.9	0.9
Emergent herbaceous wetlands	0.0	0.0	0.2	0.0	4.1	0.0
Barren land	0.0	0.0	0.0	0.0	0.0	0.0
Developed	0.0	0.0	0	0.0	4.7	0.0
Grand total	**611.5**	**100.0**	**4,523.9**	**100.0**	**17,895.8**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 9. Alternative B vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland low and tall shrub	275.2	40.6	2,127.4	41.4	7,867.9	39.7
Upland mesic spruce forest	266.3	39.3	1,622.8	31.6	7,899.4	39.8
Upland mesic spruce-hardwood forest	36.3	5.4	254.8	5.0	1,035.8	5.2
Lowland woody wetland	24.4	3.6	228.3	4.4	683.0	3.4
Alpine and arctic tussock tundra	18.1	2.7	146.3	2.8	503.1	2.5
Grassland/herbaceous	18.1	2.7	225.8	4.4	529.1	2.7
Riparian forest and shrub	16.0	2.4	150.6	2.9	470.8	2.4
Alpine dwarf shrub tundra	15.8	2.3	248.3	4.8	490.4	2.5
Sedge/herbaceous	5.8	0.8	125.9	2.5	173.7	0.9
Open water	2.0	0.3	6.8	0.1	166.4	0.8
Barren land	0.2	0.0	0.9	0.0	6.6	0.0
Emergent herbaceous wetlands	0.0	0.0	0.0	0.0	3.1	0.0
Developed	0.0	0.0	0.0	0.0	4.7	0.0
Grand total	**678.3**	**100.0**	**5,137.9**	**100.0**	**19,834.2**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 10. Alternative C vegetation impact acres and percentages

Vegetation types	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint	Area (%)	Area (acres) dust: 328 feet[a]	Area (%)
Upland mesic spruce forest	259.7	28.0	2,111.4	25.7	7,551.5	28.9
Upland low and tall shrub	222.2	24.0	1,914.6	23.3	6,311.6	24.2
Riparian forest and shrub	119.2	12.9	1,178.2	14.4	3,247.8	12.4
Lowland woody wetland	110.5	11.9	729.7	8.9	3,138.0	12.0
Alpine and arctic tussock tundra	74.4	8.0	578.9	7.1	2,045.2	7.8
Upland mesic spruce-hardwood forest	56.1	6.1	809.1	9.9	1,517.7	5.8
Sedge/herbaceous	28.5	3.1	234.7	2.9	840.9	3.2
Alpine dwarf shrub tundra	27.2	2.9	405.5	4.9	829.7	3.2
Developed	11.6	1.3	79.0	1.0	94.3	0.4
Grassland/herbaceous	10.3	1.1	115.2	1.4	243.0	0.9
Emergent herbaceous wetlands	4.7	0.5	34.0	0.4	139.4	0.5
Open water	2.5	0.3	11.9	0.1	128.9	0.5
Barren land	0.1	0.0	7.6	0.1	3.2	0.0
Unmapped	0.1	> 0.1	0.3	>0.1	1.2	>0.1
Grand total	**927.3**	**100.0**	**8,210.2**	**100.0**	**26,092.3**	**100.0**

[a] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Wetlands

Impacts to wetlands were calculated in the same manner as identified above in the vegetation section using the wetland mapping provided for the project (DOWL 2014 and 2019). Mapped wetland types were aggregated to the broad Cowardin Class levels to better facilitate comparison of impacts among the alternatives.

It should be noted that approximately 9 acres within the 328-foot buffer of Alternatives A and B are unmapped. However, this unmapped area occurs on the easternmost extent of these action alternatives and is largely composed of the Dalton Highway. The ACCS statewide wetland mapping was used in the analysis of Alternative C because this alternative was not mapped to a fine scale.

Table 11, Table 12, and Table 13 provide acreages of impacts to wetland types within the construction footprint, the 10-foot temporary construction zone, and a 328-foot buffer surrounding the footprint.

Table 11. Alternative A wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM	14.8	2.4	116.3	2.6	477.2	2.7
PFO	111.3	18.2	601.4	13.3	3,370.7	18.8
PSS	212.4	34.7	1,341.0	29.6	6,677.4	37.3
Total freshwater wetlands	**338.5**	**55.4**	**2,058.6**	**45.5**	**10,525.2**	**58.8**
PUB	0.1	>0.1	1.5	>0.1	56.9	0.3
LUB	0.0	N/A	0.0	N/A	0.0	N/A
RUB	4.7	0.8	19.1	0.4	254.9	1.4
Total waterbodies	**4.8**	**0.8**	**20.6**	**0.5**	**311.8**	**1.7**
Total wetland and waterbodies	**343.3**	**56.1**	**2,079.2**	**46.0**	**10,837.1**	**60.5**
Upland	268.2	43.9	2,444.7	54.0	7,058.8	39.4
Grand total	**611.5**	**100.0**	**4,523.9**	**100.0**	**17,895.8**	**100.0**

Note: N/A = not applicable; PEM = palustrine emergent; PFO = palustrine forested; PSS = palustrine scrub-shrub

[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.

[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 12. Alternative B wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM	15.0	2.2	118.6	2.3	485.6	2.4
PFO	152.2	22.4	858.1	16.7	4,464.8	22.5
PSS	223.5	33.0	1,414.5	27.5	6,974.8	35.2
Total freshwater wetlands	**390.7**	**57.6**	**2,391.3**	**46.5**	**11,925.2**	**60.1**
PUB	0.2	>0.1	1.5	>0.1	59.9	0.3
LUB	0.0	N/A	0.0	N/A	3.7	>0.1
RUB	5.4	0.8	23.0	0.4	281.1	1.4

Aggregated wetland type	Area (acres) construction zone/ temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
Total waterbodies	**5.6**	**0.8**	**24.6**	**0.5**	**344.8**	**1.7**
Total wetland and waterbodies	**396.3**	**58.4**	**2,415.8**	**47.0**	**12,269.9**	**61.9**
Upland	282.0	41.6	2,722.0	53.0	7,564.2	38.1
Grand total	**678.3**	**100.0**	**5,137.9**	**100.0**	**19,834.2**	**100.0**

Note: N/A = not applicable; PEM = palustrine emergent; PFO = palustrine forested; PSS = palustrine scrub-shrub;

[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.

[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 13. Alternative C wetland impact acres and percentages

Aggregated wetland type	Area (acres) construction zone / temporary: 10 feet	Area (%)	Area (acres) direct footprint[a]	Area (%)	Area (acres) dust: 328 feet[b]	Area (%)
PEM	35.0	3.8	249.8	3.1	1,000.2	3.8
PFO	97.1	10.5	677.2	8.2	2,731.2	10.5
PML	4.8	0.5	30.3	0.4	136.2	0.5
PSS	425.0	45.7	2,865.4	34.8	12,037.4	46.1
Total freshwater wetlands	**562.0**	**60.5**	**3,822.6**	**46.5**	**15,905.0**	**61.0**
PUB	1.3	0.1	9.1	0.1	59.0	0.2
LUB	>0.1	>0.1	0	N/A	5.5	0.0
RUB	8.3	0.9	58.3	0.7	320.2	1.2
Total waterbodies	**9.6**	**1.0**	**67.4**	**0.8**	**384.8**	**1.5**
Total wetland and waterbodies	**571.6**	**61.5**	**3,890.0**	**47.3**	**16,289.7**	**62.4**
Upland	355.7	38.5	4,320.2	52.7	9,802.6	37.6
Grand total	**927.3**	**100.0**	**8,210.2**	**100.0**	**26,092.3**	**100.0**

Note: N/A = not applicable; PEM = palustrine emergent; PFO = palustrine forested; PML = palustrine moss-lichen; PSS = palustrine scrub-shrub

[a] The direct footprint impacts are not meant to represent a complete loss for riverine wetlands; rather, direct footprint acreages of riverine wetlands represent alterations to these wetland types where bridges and culverts would be constructed.

[b] The 328-foot fugitive dust buffer includes the 10-foot construction zone.

Table 14. Number of culverts in wetlands (field verified) by wetland type and action alternative*

Wetland Type	Alternative A – Number of Culverts	Alternative B – Number of Culverts	Alternative C – Number of Culverts[a]
Palustrine emergent	54	58	258
Palustrine forested	254	234	190
Palustrine moss lichen	0	0	30
Palustrine scrub shrub	609	582	1,553
Ponds	1	2	7
Riverine	1,520	2,016	30
Upland	507	329	654
Grand total	**2,945**	**3,221**	**2,722**

[a] Alternative C routing was mapped using coarser data from the Alaska Center for Conservation Science and the riverine wetland type is not captured at the same level of detail as the mapping used for Alternatives A and B.

1.2. Fish and Aquatic Resources

Table 15 identifies species documented in the study area and highlights species key to this analysis. The analysis identifies a fish species as key if it is a major target of subsistence, sport, or commercial fisheries, has specialized habitat (e.g., spawning areas) in the study area that is limited elsewhere, or has essential fish habitat (EFH) designated in the study area. Table 16 provides considerations for assessing impacts to fish habitat, including anadromous stream crossings and EFH in streams. See also Volume 4, Map 3-17 and Map 3-18.

1.3. Birds*

Table 17 identifies the avian species that occur in the project area, including their common and scientific names, relative abundance, and special status designations.

Table 15. Fish species documented to occur in drainages intersected by the alternatives

Common name(s)	Traditional name(s)	Scientific name	Life history	Considerations specific to the study area	Species of Greatest Conservation Need throughout Alaska[a]
Arctic grayling[b]	***Suluqpaugaq[d], tleghelbaaye[e]***	***Thymallus arcticus***	**Resident**	**Subsistence target, sport**	**Cultural Importance**
Round whitefish	*Quptik, Savaigutnik[d], hulten’[e]*	*Prosopium cylindraceum*	Resident	Prey species; subsistence (bycatch)	Cultural Importance
Sheefish (Inconnu)[b]	***Siid, ledlaagha e***	***Stenodus leucichthys***	**Mostly Anadromous in study area**	**Subsistence target, sport, commercial**	**Stewardship Species**
Humpback whitefish[b]	***Qaalgiq, Ikkuiyiq[d], holehge[e]***	***Coregonus pidschian***	**Anadromous or Resident**	**Subsistence target**	**Cultural Importance**
Broad whitefish[b]	***Quasriluk, Siiguliaq[d], taaseze[e]***	***Coregonus nasus***	**Anadromous or Resident**	**Subsistence target**	**Cultural Importance**
Least cisco	*Qalusraaq, Iqalusaaq[d], tsaabaaye[e]*	*Coregonus sardinella*	Anadromous or Resident	Sport, prey species, subsistence	Cultural Importance
Burbot, mudshark, lush[b]	***Tittaaliq, Tiktaaliq[d] Ts’oneye[e]***	***Lota lota***	**Resident**	**Subsistence**	**Cultural and Ecological Importance**
Dolly Varden	*Qalukpik, Agalukpiq[d], seł yee lookk’[e]*	*Salvelinus malma*	Anadromous or Resident	Subsistence, sport	Cultural Importance; Stewardship Species
Chinook salmon[b, c]	***Iqalsugruk, Tagayukpuk[d]***	***Oncorhynchus tshawytscha***	**Anadromous**	**Subsistence target, EFH**	**Cultural and Economic Importance; Stewardship**
Chum salmon[b, c]	***Qalugruaq, Aqalugruaq[d]***	***Oncorhynchus keta***	**Anadromous**	**Subsistence target, EFH, commercial**	**Cultural and Economic Importance**
Coho salmon[b]	***Not applicable***	***Oncorhynchus kisutch***	**Anadromous**	**Subsistence target, EFH**	**Cultural and Economic Importance; Stewardship**
Sockeye salmon[b]	***Not applicable***	***Oncorhynchus nerka***	**Anadromous**	**EFH**	**Cultural and Economic Importance; Stewardship**
Northern pike[b]	***Siulik, Siilik[d], K’oolkkoye[e]***	***Esox lucius***	**Resident**	**Subsistence target, sport**	**Cultural and Economic Importance**
Arctic lamprey, eel	*Dots’e tl’ egheze, Dots’ e tl’ ool[e]*	*Lampetra camtschatica*	Anadromous	Prey species (subsistence outside of study area)	Cultural Importance
Arctic char	*Igalukpiq, Qalukpik[d]*	*Salvelinus alpinus*	Resident	Subsistence, sport	Cultural Importance
Lake trout	*Kanaak, Akmaguk[d], qalukpik, tl’uhlaaghe[e]*	*Salvelinus namaycush*	Resident	Subsistence, sport	Cultural Importance
Alaska blackfish[b]	***Iłuuqiñiq, Iłuiqiñiq[d] Oonyeeyh[e]***	***Dallia pectoralis***	**Resident**	**Subsistence; culturally significant**	**Cultural Importance**
Lake chub	*Lake herring, tokkodooze[e]*	*Couesius plumbeus*	Resident	Prey species	Ecological Importance
Longnose sucker	*Kaviqsuaq, Milugiaq[d] toonts’ode[e]*	*Catostomus catostomus*	Resident	Prey species	Not applicable
Slimy sculpin	*Netsoo tlee’[e]*	*Cottus cognatus*	Resident	Prey species	Not applicable
Ninespine stickleback	*Kakilniuk[d]*	*Pungitius pungitius*	Resident	Prey species	Ecological Importance

Sources: ABR 2014a; ADF&G 2015, 2019; Anderson et al. 2004; Esse and Kretsinger 2009; Johnson and Blossom 2018a, 2018b; Jones 2006; Kretsinger et al. 1994; Lemke et al. 2013; McKenna 2015; Scannell 2015; Wuttig et al. 2015

Note: EFH = essential fish habitat

[a] ADF&G (2015) identifies 58 fish species as species of greatest conservation need (SGCN) in Alaska; none is listed as “at-risk” (species whose population is small, declining, or under significant threat). SGCN, based on multiple criteria, include species that are culturally, ecologically, or economically important; species with a high percentage of their North American or global population in Alaska (stewardship species); and species that function as indicators of environmental change (sentinel species).

[b] Species shown in bold (strong text) and followed with a superscript of “b” are major targets of a subsistence, sport, or commercial fishery in the study area; have specialized habitat (e.g., spawning area) in the study area that is limited elsewhere; or have EFH designated in the study area and are considered key to this analysis. The Alaska blackfish is a focus species for this analysis because of its cultural significance within the study area (S. Whiting, personal communication 2019).

[c] Chinook and chum salmon returns to the Yukon and other rivers in northwest Alaska have declined since the late 1990s (McKenna 2015). Chum salmon in Clear Creek, a tributary of the Hogatza River, is on the BLM’s “Watchlist Animals” list of the “BLM Alaska Special Status Species List” but are not currently recognized as a sensitive species (BLM 2019; Esse and Kretsinger 2009; Kretsinger et al. 1994).

[d] Iñupiaq names based on Jones 2006.

[e] Koyukon names based on Anderson et al. 2004.

Table 16. Considerations for assessing impacts to fish habitat – anadromous stream crossings and essential fish habitat in streams

Number of stream crossings and proximity of road and gravel sites to fish streams	Alternative A	Alternative B	Alternative C
Number of essential fish habitat[a] crossings	13	14	21
Number of known anadromous streams[b] crossings	17	18	26
Number of crossings of assumed anadromous[c] streams	23	25	244
Total number of known and/or assumed anadromous[d] fish stream crossings	40	43	270
Number of bridge crossings	29	26	251
Number of moderate and major culverts proposed[d]	34	24	272
Number of minor culverts proposed[f]	2,869	3,155	4,076
Acreage of fish habitat affected by bridges[g], which may result in loss of spawning habitat	2,025	2,021	4,092
Acreage of fish habitat affected by culverts[h], which may result in loss of spawning habitat	84.5	88.5	181
Linear miles of fish stream habitat affected by properly maintained bridges[g]	13.4	10.5	57.4
Linear miles of fish stream habitat affected by properly maintained fish passage culverts[h]	70.1	76.4	110
Total length of road in miles, excluding access roads	211	228	332
Miles of road located within major floodplains[i], excluding access roads	4.6	5.4	53.6
Miles of road located within 1,000 feet of major floodplain[i], excluding access roads	16.1	17.3	96.3
Miles of road located within 1,000 feet of National Hydrography Dataset streams, excluding access roads	16.0	20.2	83.3
Total number of gravel mines proposed	41	46	44
Number of gravel mines within floodplain[i] or in low-lying areas within 500 feet of fish streams[j]	21	22	16
Number of gravel mines located within 300 feet of essential fish habitat a streams	3	4	6
Number of gravel mines within 300 feet of known and/or assumed anadromous[d] streams	8	11	18

[a] Based on crossings of salmon streams identified in the Anadromous Waters Catalog (Johnson and Blossom 2018a, 2018b) and streams recently nominated for inclusion into the AWC, by ADF&G staff (Geifer et al. 2019).
[b] Based on crossings of streams identified in the Anadromous Waters Catalog (Johnson and Blossom 2018a, 2018b) and streams recently nominated for inclusion into the AWC, by ADF&G staff (Geifer et al. 2019).
[c] Based on streams assumed by AIDEA and DOWL to support anadromous fish (received GIS data 2019).
[d] Includes data from the AWC and those streams that AIDEA and DOWL assume to be anadromous.
[e] Moderate culverts would be 4 to 10 feet in diameter and major culverts would be 10 to 20 feet wide. AIDEA made an estimate at the application stage of the number of major, moderate, and minor culverts that would be needed for the project. AIDEA has committed to using stream simulation principles to design culverts at all fish-bearing streams in order to provide fish passage and minimize potential adverse impacts to fish and aquatic life. At the construction stage AIDEA will be required to use culverts sized appropriately for the drainage and to meet fish passage requirements where necessary, even if their application stage estimate was different.
[f] Minor culverts would be 3 feet or less in diameter. AIDEA estimated the number of minor culvert crossings but did not provide crossing locations or stream data at the same resolution for all alternatives, so it is difficult to estimate the number of minor culverts intended to convey perennial stream flow and pass fish, as opposed to those intended to facilitate cross drainage or maintain wetland connectivity in areas that do not support fish. AIDEA made an estimate at the application stage of the number of major, moderate, and minor culverts that would be needed for the project (as shown in this table). At the construction stage, AIDEA will be required to use culverts sized appropriately for the drainage and to meet fish passage requirements where necessary, even if their application stage estimate was different. In some cases 'minor' culverts may not be large enough to adequately pass fish, particularly using stream simulation principles, and therefore, some culverts in fish-bearing habitat may be resized through coordination with ADF&G prior to construction, during permitting.
[g] The bridge length was assumed to be an average of 50 feet for small bridges, 120 feet for medium bridges, and the actual length for the large bridges. Assuming that the stream/floodplain would be impacted by the bridge crossings up to five times the bridge length both upstream and downstream allowed an estimate of the area of floodplain impacts due to the bridges.
[h] The culvert width was assumed to be an average of 3 feet for minor culverts, 10 feet for moderate culverts, and 20 feet for major culverts. Assuming that the stream/floodplain would be impacted by the culvert crossings up to five times the culvert width plus a roadway embankment at a 4:1 slope for Phase 3 width both upstream and downstream allowed an estimate of the area of floodplain impacts due to culverts.
[i] Based on vegetative floodplain mapping for the Central Yukon Region (BLM 2016).
[j] Based on review of aerial imagery, LIDAR, contour data, available stream and fish data from multiple sources and proposed material site locations in geographic information systems (GIS) software. DOWL (2014) cautions that densely vegetated habitat precluded identification of some drainages (less than 12 feet wide) in some areas.

Table 17. Avian species in the project area*

Species group	Common name[a]	Scientific name[a]	Relative abundance in the project area[b]	Occurrence in the project area[c]	USFWS[d]	BLM[e]	ADF&G[f]	AUD[g]	IUCN[h]	BPIF[i]	Source
Waterfowl	Snow goose	*Anser caerulescens*	R	M	—	—	—	—	—	—	ACCS 2009
Waterfowl	Greater white-fronted goose	*Anser albifrons*	U	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Brant	*Branta bernicla*	R	M	—	—	—	—	—	—	Harwood 2023
Waterfowl	Cackling goose	*Branta hutchinsii*	U	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Canada goose	*Branta canadensis*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Trumpeter swan	*Cygnus buccinator*	C	B	—	W	—	—	—	—	ACCS 2009
Waterfowl	Tundra swan	*Cygnus columbianus*	U	M	—	—	—	—	—	—	ACCS 2009
Waterfowl	Northern shoveler	*Spatula clypeata*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Gadwall	*Mareca strepera*	U	M	—	—	—	—	—	—	ACCS 2009
Waterfowl	American wigeon	*Mareca americana*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Mallard	*Anas platyrhynchos*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Northern pintail	*Anas acuta*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Green-winged teal	*Anas crecca*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Canvasback	*Aythya valisineria*	R	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Redhead	*Aythya americana*	R	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Ring-necked duck	*Aythya collaris*	U	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Greater scaup	*Aythya marila*	C	B	—	—	—	RL	—	—	ACCS 2009
Waterfowl	Lesser scaup	*Aythya affinis*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Harlequin duck	*Histrionicus histrionicus*	R	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Surf scoter	*Melanitta perspicillata*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	White-winged scoter	*Melanitta deglandi*	C	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Black scoter	*Melanitta americana*	U	B	—	—	AR	RL	NT	—	ACCS 2009
Waterfowl	Long-tailed duck	*Clangula hyemalis*	C	B	—	—	—	—	VU	—	ACCS 2009
Waterfowl	Bufflehead	*Bucephala albeola*	U	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Common goldeneye	*Bucephala clangula*	U	B	—	—	—	—	—	—	ACCS 2009
Waterfowl	Common merganser	*Mergus merganser*	R	B	—	—	—	—	—	—	Harwood 2023
Waterfowl	Red-breasted merganser	*Mergus serrator*	C	B	—	—	—	—	—	—	ACCS 2009
Grouse and Ptarmigan	Ruffed grouse	*Bonasa umbellus*	U	RE	—	—	—	—	—	—	ACCS 2009
Grouse and Ptarmigan	Spruce grouse	*Canachites canadensis*	C	RE	—	—	—	—	—	—	ACCS 2009
Grouse and Ptarmigan	Willow ptarmigan	*Lagopus lagopus*	C	RE	—	—	—	—	—	CS	DeGroot and McMillan 2012
Grouse and Ptarmigan	Rock ptarmigan	*Lagopus muta*	C	RE	—	—	—	—	—	—	ACCS 2009
Grouse and Ptarmigan	Sharp-tailed grouse	*Tympanuchus phasianellus*	U	RE	—	—	—	—	—	—	ACCS 2009
Loons and Grebes	Horned grebe	*Podiceps auritus*	C	B	—	—	—	—	VU	—	ACCS 2009
Loons and Grebes	Red-necked grebe	*Podiceps grisegena*	U	B	—	—	—	RL	—	—	ACCS 2009
Cranes	Sandhill crane	*Antigone canadensis*	R	B	—	—	—	—	—	—	ACCS 2009

Species group	Common name[a]	Scientific name[a]	Relative abundance in the project area[b]	Occurrence in the project area[c]	USFWS[d]	BLM[e]	ADF&G[f]	AUD[g]	IUCN[h]	BPIF[i]	Source
Shorebirds	American golden-plover	*Pluvialis dominica*	U	B	BCC	W	AR	RL	—	—	ACCS 2009
Shorebirds	Semipalmated plover	*Charadrius semipalmatus*	U	M	—	—	—	—	—	—	ACCS 2009
Shorebirds	Upland sandpiper	*Bartramia longicauda*	R	B	—	—	AR	—	—	—	ACCS 2009
Shorebirds	Whimbrel	*Numenius phaeopus*	U	B	—	S	AR	YL	—	—	ACCS 2009
Shorebirds	Hudsonian godwit	*Limosa haemastica*	U	B	BCC	S	AR	—	—	—	ACCS 2009
Shorebirds	Surfbird	*Calidris virgata*	U	B	—	—	AR	YL	—	—	ACCS 2009
Shorebirds	Baird's sandpiper	*Calidris bairdii*	U	B	—	—	—	—	—	—	ACCS 2009
Shorebirds	Least sandpiper	*Calidris minutilla*	C	B	—	—	—	—	—	—	ACCS 2009
Shorebirds	Pectoral sandpiper	*Calidris melanotos*	U	M	BCC	—	AR	—	—	—	Harwood 2023
Shorebirds	Semipalmated sandpiper	*Calidris pusilla*	U	B	—	—	AR	—	NT	—	ACCS 2009
Shorebirds	Long-billed dowitcher	*Limnodromus scolopaceus*	U	M	—	—	—	—	—	—	ACCS 2009
Shorebirds	Wilson's snipe	*Gallinago delicata*	U	B	—	—	—	—	—	—	ACCS 2009
Shorebirds	Spotted sandpiper	*Actitis macularius*	U	B	—	—	AR	—	—	—	ACCS 2009
Shorebirds	Solitary sandpiper	*Tringa solitaria*	U	B	BCC	—	AR	YL	—	—	ACCS 2009
Shorebirds	Wandering tattler	*Tringa incana*	U	B	BCC	—	—	YL	—	—	ACCS 2009
Shorebirds	Lesser yellowlegs	*Tringa flavipes*	C	B	BCC	—	AR	RL	—	—	ACCS 2009
Shorebirds	Red-necked phalarope	*Phalaropus lobatus*	U	B	—	—	—	—	—	—	ACCS 2009
Larids	Long-tailed jaeger	*Stercorarius longicaudus*	R	B	—	—	—	—	—	—	Harwood 2023
Larids	Bonaparte's gull	*Chroicocephalus philadelphia*	R	B	—	—	—	—	—	—	ACCS 2009
Larids	Short-billed gull	*Larus brachyrhynchus*	C	B	—	—	—	—	—	—	ACCS 2009
Larids	Herring gull	*Larus argentatus*	C	B	—	—	AR	—	—	—	ACCS 2009
Larids	Glaucous gull	*Larus hyperboreus*	R	M	—	—	—	—	—	—	Harwood 2023
Larids	Arctic tern	*Sterna paradisaea*	C	B	—	—	AR	—	—	—	ACCS 2009
Loons and Grebes	Red-throated loon	*Gavia stellata*	R	B	—	S	AR	—	—	—	ACCS 2009
Loons and Grebes	Pacific loon	*Gavia pacifica*	U	B	—	—	—	—	—	—	ACCS 2009
Loons and Grebes	Common loon	*Gavia immer*	C	B	—	—	—	—	—	—	ACCS 2009
Hawks and Eagles	Osprey	*Pandion haliaetus*	C	B	—	—	—	—	—	—	Ritchie 2013
Hawks and Eagles	Golden eagle	*Aquila chrysaetos*	C	B	—	—	AR	—	—	—	Ritchie 2013
Hawks and Eagles	Northern harrier	*Circus hudsonius*	C	B	—	—	AR	—	—	—	Ritchie 2013
Hawks and Eagles	Sharp-shinned hawk	*Accipiter striatus*	U	B	—	—	—	—	—	—	Ritchie 2013
Hawks and Eagles	Northern goshawk	*Accipiter gentilis*	C	RE	—	—	—	—	—	CS	Ritchie 2013
Hawks and Eagles	Bald eagle	*Haliaeetus leucocephalus*	C	B	—	—	—	—	—	CS	Ritchie 2013
Hawks and Eagles	Red-tailed hawk	*Buteo jamaicensis*	C	B	—	—	AR	—	—	—	Ritchie 2013
Hawks and Eagles	Rough-legged hawk	*Buteo lagopus*	U	B	—	—	—	—	—	—	Ritchie 2013
Owls	Great horned owl	*Bubo virginianus*	U	RE	—	—	—	—	—	—	Ritchie 2013
Owls	Snowy owl	*Bubo scandiacus*	R	M	BCC	—	AR	—	—	W	Harwood 2023
Owls	Northern hawk owl	*Surnia ulula*	U	RE	—	—	AR	—	—	CS	Ritchie 2013
Owls	Great gray owl	*Strix nebulosa*	U	RE	—	—	AR	—	—	—	Ritchie 2013
Owls	Short-eared owl	*Asio flammeus*	U	B	BCC	W	AR	—	—	CBSD	Ritchie 2013

Species group	Common name[a]	Scientific name[a]	Relative abundance in the project area[b]	Occurrence in the project area[c]	USFWS[d]	BLM[e]	ADF&G[f]	AUD[g]	IUCN[h]	BPIF[i]	Source
Owls	Boreal owl	*Aegolius funereus*	U	B	—	—	AR	—	—	—	Ritchie 2013
Kingfishers	Belted kingfisher	*Megaceryle alcyon*	U	B	—	—	AR	—	—	—	ACCS 2009
Woodpeckers	American three-toed woodpecker	*Picoides dorsalis*	R	RE	—	—	—	—	—	—	ACCS 2009
Woodpeckers	Black-backed woodpecker	*Picoides arcticus*	R	RE	—	—	—	—	—	—	ACCS 2009
Woodpeckers	Downy woodpecker	*Dryobates pubescens*	C	RE	—	—	—	—	—	—	ACCS 2009
Woodpeckers	Hairy woodpecker	*Dryobates villosus*	C	RE	—	—	—	YL	—	—	ACCS 2009
Woodpeckers	Northern flicker	*Colaptes auratus*	C	B	—	—	AR	—	—	—	ACCS 2009
Falcons	American kestrel	*Falco sparverius*	U	B	—	—	AR	—	—	—	Ritchie 2013
Falcons	Merlin	*Falco columbarius*	U	B	—	—	—	—	—	—	Ritchie 2013
Falcons	Gyrfalcon	*Falco rusticolus*	R	RE	—	W	AR	—	—	—	Ritchie 2013
Falcons	Peregrine falcon	*Falco peregrinus*	C	B	—	—	—	—	—	—	Ritchie 2013
Passerines	Olive-sided flycatcher	*Contopus cooperi*	U	B	BCC	S	AR	RL	—	W	DeGroot and McMillan 2012
Passerines	Western wood-pewee	*Contopus sordidulus*	R	B	—	—	AR	RL	—	CBSD	ACCS 2009
Passerines	Yellow-bellied flycatcher	*Empidonax flaviventris*	R	V	—	—	—	—	—	—	Harwood 2023
Passerines	Alder flycatcher	*Empidonax alnorum*	C	B	—	—	AR	—	—	—	ACCS 2009
Passerines	Hammond's flycatcher	*Empidonax hammondii*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Say's phoebe	*Sayornis saya*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Northern shrike	*Lanius borealis*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Canada jay	*Perisoreus canadensis*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Black-billed magpie	*Pica hudsonia*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Common raven	*Corvus corax*	C	B	—	—	—	—	—	—	DeGroot and McMillan 2012
Passerines	Black-capped chickadee	*Poecile atricapillus*	U	RE	—	—	—	—	—	—	ACCS 2009
Passerines	Boreal chickadee	*Poecile hudsonicus*	C	RE	—	—	AR	—	—	—	DeGroot and McMillan 2012
Passerines	Gray-headed chickadee	*Poecile cinctus*	U	RE	BCC	S	—	RL	—	—	DeGroot and McMillan 2012
Passerines	Horned lark	*Eremophila alpestris*	U	B	—	—	AR	—	—	CBSD	ACCS 2009
Passerines	Bank swallow	*Riparia riparia*	U	B	—	W	AR	RL	—	CBSD	DeGroot and McMillan 2012
Passerines	Tree swallow	*Tachycineta bicolor*	U	B	—	—	AR	—	—	—	ACCS 2009
Passerines	Violet-green swallow	*Tachycineta thalassina*	U	B	—	—	—	RL	—	—	ACCS 2009
Passerines	Cliff swallow	*Petrochelidon pyrrhonota*	U	B	—	—	—	—	—	—	DeGroot and McMillan 2012
Passerines	Arctic warbler	*Phylloscopus borealis*	U	B	—	—	—	—	—	CBSD, CS	DeGroot and McMillan 2012
Passerines	Ruby-crowned kinglet	*Corthylio calendula*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Bohemian waxwing	*Bombycilla garrulus*	C	B	—	—	—	—	—	CBSD	ACCS 2009
Passerines	American dipper	*Cinclus mexicanus*	U	RE	—	—	—	—	—	—	ACCS 2009
Passerines	Mountain bluebird	*Sialia currucoides*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Townsend's solitaire	*Myadestes townsendi*	R	B	—	—	—	—	—	—	Harwood 2023
Passerines	Gray-cheeked thrush	*Catharus minimus*	C	B	—	—	—	—	—	CS	DeGroot and McMillan 2012
Passerines	Swainson's thrush	*Catharus ustulatus*	U	B	—	—	AR	—	—	—	ACCS 2009
Passerines	Hermit thrush	*Catharus guttatus*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	American robin	*Turdus migratorius*	C	B	—	—	—	—	—	—	DeGroot and McMillan 2012

Species group	Common name[a]	Scientific name[a]	Relative abundance in the project area[b]	Occurrence in the project area[c]	USFWS[d]	BLM[e]	ADF&G[f]	AUD[g]	IUCN[h]	BPIF[i]	Source
Passerines	Varied thrush	*Ixoreus naevius*	C	B	—	—	AR	—	—	CBSD, CS	ACCS 2009
Passerines	Bluethroat	*Cyanecula svecica*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Northern wheatear	*Oenanthe oenanthe*	U	B	—	—	—	—	—	CS	ACCS 2009
Passerines	Eastern yellow wagtail	*Motacilla tschutschensis*	R	V	—	—	—	—	—	—	Harwood 2023
Passerines	American pipit	*Anthus rubescens*	U	B	—	—	AR	—	—	—	ACCS 2009
Passerines	Pine grosbeak	*Pinicola enucleator*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Gray-crowned rosy-finch	*Leucosticte tephrocotis*	C	B	—	—	—	—	—	CS	ACCS 2009
Passerines	Common redpoll	*Acanthis flammea*	C	B	—	—	AR	—	—	CBSD, CS	DeGroot and McMillan 2012
Passerines	Hoary redpoll	*Acanthis hornemanni*	U	RE	—	—	—	—	—	—	DeGroot and McMillan 2012
Passerines	White-winged crossbill	*Loxia leucoptera*	C	RE	—	—	—	—	—	—	ACCS 2009
Passerines	Pine siskin	*Spinus pinus*	R	B	—	—	AR	—	—	CBSD	Harwood 2023
Passerines	Lapland longspur	*Calcarius lapponicus*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Smith's longspur	*Calcarius pictus*	R	B	—	S	AR	—	—	—	Handel et al. 2021, NPS 2021
Passerines	Snow bunting	*Plectrophenax nivalis*	U	B	—	—	AR	—	—	CBSD	ACCS 2009
Passerines	Fox sparrow	*Passerella iliaca*	C	B	—	—	AR	—	—	CS	DeGroot and McMillan 2012
Passerines	American tree sparrow	*Spizelloides arborea*	C	B	—	—	AR	—	—	CBSD, CS	DeGroot and McMillan 2012
Passerines	Dark-eyed junco	*Junco hyemalis*	C	B	—	—	—	—	—	CS	ACCS 2009
Passerines	White-crowned sparrow	*Zonotrichia leucophrys*	C	B	—	—	AR	—	—	CS	DeGroot and McMillan 2012
Passerines	Golden-crowned sparrow	*Zonotrichia atricapilla*	U	B	—	—	—	—	—	CS	ACCS 2009
Passerines	Savannah sparrow	*Passerculus sandwichensis*	U	B	—	—	AR	—	—	—	DeGroot and McMillan 2012
Passerines	Lincoln's sparrow	*Melospiza lincolnii*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Red-winged blackbird	*Agelaius phoeniceus*	U	B	—	—	—	—	—	—	ACCS 2009
Passerines	Rusty blackbird	*Euphagus carolinus*	U	B	—	S	AR	—	VU	CBSD	DeGroot and McMillan 2012
Passerines	Northern waterthrush	*Parkesia noveboracensis*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Orange-crowned warbler	*Leiothlypis celata*	C	B	—	—	AR	RL	—	CS	DeGroot and McMillan 2012
Passerines	Yellow warbler	*Setophaga petechia*	C	B	—	—	AR	YL	—	—	ACCS 2009
Passerines	Blackpoll warbler	*Setophaga striata*	U	B	—	W	AR	RL	—	CBSD	ACCS 2009
Passerines	Yellow-rumped warbler	*Setophaga coronata*	C	B	—	—	—	—	—	—	ACCS 2009
Passerines	Townsend's warbler	*Setophaga townsendi*	U	B	—	W	—	—	—	CS	ACCS 2009
Passerines	Wilson's warbler	*Cardellina pusilla*	C	B	—	—	AR	—	—	CBSD, CS	ACCS 2009

[a] Source: Chesser et al. 2022
[b] C = Common; R = Rare; U = Uncommon
[c] B = Breeder; M = Migrant; RE = Resident, V = Vagrant
[d] CC = Conservation Concern. Source: USFWS 2021
[e] S = Sensitive, W = Watchlist. Source: BLM 2019.
[f] AR = At Risk. Source: ADF&G 2015
[g] RL = Red List, YL = Yellow List. Source: Warnock 2017a, 2017b
[h] NT = Near Threatened, VU = Vulnerable. Source: IUCN 2019
[i] CBSD = Common Bird in Steep Decline, CS = Continental Stewardship, W = Watchlist. Source: Handel et al. 2021

1.4. Mammals*

1.4.1 Affected Environment

Table 18 lists mammal species in the project area, including common and scientific names, abundance, and special status designations.

Table 18. Mammal species in the project area*

Type	Common name	Scientific name	Abundance	BLM	ADF&G
Large Herbivores	Caribou	*Rangifer tarandus*	Common	N/A	N/A
Large Herbivores	Moose	*Alces americanus*	Common	N/A	N/A
Large Herbivores	Dall sheep	*Ovis dalli*	Rare	N/A	N/A
Large Herbivores	Muskoxen	*Ovibos moschatus*	Rare	N/A	N/A
Large Carnivores	Black bear	*Ursus americanus*	Common	N/A	N/A
Large Carnivores	Coyote	*Canis latrans*	Rare	N/A	N/A
Large Carnivores	Gray wolf	*Canis lupus*	Common	N/A	N/A
Large Carnivores	Grizzly (brown) bear	*Ursus arctos*	Uncommon	N/A	N/A
Large Carnivores	Lynx	*Lynx canadensis*	Uncommon	N/A	N/A
Large Carnivores	Red fox	*Vulpes vulpes*	Common	N/A	N/A
Large Carnivores	Wolverine	*Gulo gulo*	Uncommon	N/A	N/A
Small Mammals	Alaska marmot	*Marmota broweri*	Common	N/A	N/A
Small Mammals	Holarctic least shrew (formerly Alaska tiny shrew)	*Sorex minutissimus*	Rare	N/A	N/A
Small Mammals	American beaver	*Castor canadensis*	Common	N/A	N/A
Small Mammals	American marten	*Martes americana*	Uncommon	N/A	N/A
Small Mammals	American pigmy shrew	*Sorex hoyi*	Uncommon	N/A	N/A
Small Mammals	Arctic ground squirrel	*Spermophilus parryii*	Common	WL	N/A
Small Mammals	Cinereus shrew	*Sorex cinereus*	Common	N/A	N/A
Small Mammals	Collared pika	*Ochotona collaris*	Uncommon	N/A	N/A
Small Mammals	Dusky (montane) shrew	*Sorex monticolus*	Common	N/A	N/A
Small Mammals	Ermine	*Mustela erminea*	Common	N/A	N/A
Small Mammals	Least weasel	*Mustela nivalis*	Common	N/A	N/A
Small Mammals	Little brown bat (myotis)	*Myotis lucifugus*	Rare	WL	N/A
Small Mammals	Meadow vole	*Microtus pennsylvanicus*	Common	N/A	SGCN
Small Mammals	Mink	*Mustela vison*	Common	N/A	N/A
Small Mammals	Muskrat	*Ondatra zibethicus*	Common	N/A	N/A
Small Mammals	Neararctic brown lemming	*Lemmus trimucronatus*	Common	N/A	SGCN
Small Mammals	Neararctic collared lemming	*Discrostonyx groelandicus*	Uncommon	N/A	N/A
Small Mammals	North American river otter	*Lontra canadensis*	Common	N/A	N/A
Small Mammals	Northern bog lemming	*Synaptomys borealis*	Common	WL	SGCN
Small Mammals	Northern flying squirrel	*Glaucomys sabrinus*	Rare	N/A	SGCN
Small Mammals	Northern red-backed vole	*Myodes rutilus*	Common	N/A	SGCN

Type	Common name	Scientific name	Abundance	BLM	ADF&G
Small Mammals	Porcupine	*Erethizon dorsatum*	Common	N/A	N/A
Small Mammals	Red squirrel	*Tamiasciurus hudsonicus*	Uncommon	N/A	SGCN
Small Mammals	Root vole (tundra vole)	*Microtus oeconomus*	Common	N/A	SGCN
Small Mammals	Singing vole	*Microtus miurus*	Common	N/A	SGCN
Small Mammals	Snowshoe hare	*Lepus americanus*	Common	N/A	SGCN
Small Mammals	Tundra shrew	*Sorex tundrensis*	Common	N/A	SGCN
Small Mammals	Yellow-cheeked (taiga) vole	*Microtus xanthognathus*	Common	N/A	SGCN

Source: ACCS, UAA 2019; ADF&G 2015; BLM 2019; MacDonald and Cook 2009; NPS 2019

Note: ADF&G = Alaska Department of Fish and Game; BLM = Bureau of Land Management; N/A = not applicable; SGCN = State of Alaska Species of Greatest Conservation Need; WL = BLM Watch List Species

1.4.2 Environmental Consequences

Table 19 includes habitat loss within the 95 percent contours for both fall and winter for each alternative.

Table 19. Loss of caribou habitat (in acres) by herd and range type for each action alternative*

Herd/Range	Alternative A	Alternative B	Alternative C
WAH migratory[a]	1,287	1,347	419
WAH winter[a]	1,128	1,128	1,615
WAH peripheral[a]	1,745	2,300	2,086
WAH total[a, b]	4,161	4,775	4,120
WAH winter high-density (2002–2007)[c]	2,882	3,491	1,230
WAH winter high-density (2007–2012)[c]	2,370	2,979	1,015
WAH winter high-density (2012–2017)[c]	0	0	0
WAH winter high-density (2017–2021)[c]	5,495	5,209	4,035
RMH summer[a]	0	0	1,329
RMH total[a, b]	0	0	1,964

Note: WAH = Western Arctic Caribou Herd; RMH = Ray Mountains Herd.
[a] ADF&G 2017; see Volume 4, Map 3-21
[b] Total is entire known range, including seasonal ranges.
[c] ADF&G 2019; see Volume 4, Map 3-23; winter: November 8 – May 5.

Table 20 provides a summary of potential impacts to terrestrial mammals from the road.

Table 20. Potential impacts to terrestrial mammals

Project component	Effect type	Potential effect	Extent	Duration
Construction	Habitat loss and alteration	Habitat loss from vegetation removal and gravel fill placement	Site-specific	Long-term
Construction and operation	Habitat loss and alteration	Habitat alteration due to gravel spray, fugitive dust, thermokarst, drifted snow, and contamination of soils or water	Local	Long-term
Construction and operation	Habitat loss and alteration	Early snowmelt due to deposition of fugitive dust	Local	Long-term

Project component	Effect type	Potential effect	Extent	Duration
Construction and operation	Disturbance and displacement	Displacement of terrestrial mammals away from construction activity, air traffic, and truck traffic	Project area-wide	Long-term
Construction and operation	Disturbance and displacement	Avoidance of high-quality habitat and critical range due to displacement	Project area-wide	Long-term
Construction and operation	Disturbance and displacement	Attraction to human infrastructure when scavenging for food, as a movement corridor, or as escape from insect harassment	Local	Long-term
Construction and operation	Disturbance and displacement	Disturbance and altered behavior due to noise pollution, light pollution, and human activities associated with construction and operation	Local	Long-term
Construction and operation	Disturbance and displacement	Alteration of movement patterns including delays and deflections to the road and human activity	Project area-wide	Long-term
Construction and operation	Injury and mortality	Injury or mortality of terrestrial mammals due to vehicle or aircraft strikes	Site-specific	Long-term
Construction and operation	Injury and mortality	Contamination of roadside forage due to dust or other contaminants	Local	Long-term

Table 21. The median snow depth and estimated percentage of plant top cover comprised of lichen within 3.1 mile (5 km) of the alternatives and within Western Arctic Caribou Herd winter range (within 95% or 50% isopleth at least 1 year)*.

	Year	Winter Range[2] (95%[1])	A (95%[1])	B (95%[1])	C (95%[1])	High-Density Winter Range[2] (50%[2])	A (50%[2])	B (50%[2])	C (50%[2])
Lichen (%)[3]	1985	4.17	4.44	4.44	3.45	4.55	4.56	4.55	4.21
	1990	4.12	4.31	4.37	2.70	4.58	4.60	4.65	4.05
	1995	4.20	4.22	4.32	3.41	4.68	4.58	4.70	4.19
	2000	4.25	4.25	4.41	3.49	4.75	4.59	4.81	4.35
	2005	4.42	4.75	4.94	4.13	4.83	4.73	5.02	4.52
	2010	4.46	4.84	5.06	4.24	4.90	4.74	5.09	4.60
	2015	4.50	4.92	5.16	4.38	4.95	4.77	5.16	4.70
	2020	4.53	5.00	5.25	4.53	5.00	4.80	5.23	4.80
Median Snow Depth (m)[4]		0.75	0.97	0.95	0.72	0.78	1.07	1.03	0.80

Note: WAH = Western Arctic Caribou Herd

1. The 95% isopleth encompasses 95% of the herd distribution and therefore includes areas of high and low density. The 50% isopleth encompasses 50% of the herd distribution and defines an area of higher density.
2. Winter range was defied as all areas within the 95% or 50% isopleth in at least 1 year.
3. Percent top cover of lichen based on Macander et al. (2022) within the area used at least 1 year for high density (50%) or low or high density (95%) winter range by the WAH.
4. Median of maximum snow depth recorded each year (1990–2020) based on ERA-5 snow depth models.

Table 22. The estimated percentage of the winter distribution of the Western Arctic Caribou Herd within 3.1 miles (5 km) and 30 miles (48 km) of each proposed road alignment based on kernel density estimation calculated using radio collar data*.

Distance	Years	Alternative A	Alternative B	Alternative C
3.1 miles	1987–1997	0.648	0.702	0.629
	1998–2003	1.844	2.017	1.747
	2004–2009	1.455	1.569	1.236
	2010	3.722	3.984	1.936
	2011	0.947	1.042	1.223
	2012	0.182	0.184	0.304
	2013	0.504	0.502	0.005
	2014	0.013	0.011	0.006
	2015	0.003	0.003	0
	2016	0.375	0.43	0.323
	2017	0.747	0.789	0.708
	2018	0.799	0.798	0.578
	2019	0.793	0.819	1.066
	2020	1.555	1.516	0.123
	2021	4.004	4.035	4.597
	2022	0.654	0.733	1.383
30 miles	1987–1997	6.533	6.804	6.218
	1998–2003	17.237	17.992	15.821
	2004–2009	13.456	13.869	11.685
	2010	28.203	28.828	18.258
	2011	9.652	10.318	9.999
	2012	2.037	2.042	2.766
	2013	4.012	3.868	0.28
	2014	0.515	0.490	0.205
	2015	0.076	0.076	0.009
	2016	3.277	3.385	3.164
	2017	9.13	9.375	6.867
	2018	9.424	9.279	6.440
	2019	8.745	8.829	10.641
	2020	16.166	15.657	3.339
	2021	40.639	40.667	44.704
	2022	6.39	6.583	11.111

Table 23. The miles of road in areas used for annual winter range (95% isopleth from annual kernel density estimation) or annual high density winter range (50% isopleth from kernel density estimation in different numbers of years 1987–2022 (some years with low numbers of collars were combined for analysis resulting in a maximum of 16 years)*.

Number of Years	Alternative A High Density Wintering Areas (50%)	Alternative A Wintering Areas (95%)	Alternative B High Density Wintering Areas (50%)	Alternative B Wintering Areas (95%)	Alternative C High Density Wintering Areas (50%)	Alternative C Wintering Areas (95%)
0	81.13	0	81.13	0	192.13	50.58
1	1.62	0	1.62	0	66.87	63.39
2	26.61	0	74.99	0	0.08	16.31
3	56.75	0	25.55	0	8.45	19.33
4	35.07	0	35.07	0	35.96	3.81
5	9.88	41.35	9.88	41.35	20.60	63.22
6	0	13.31	0	13.31	8.02	2.02
7	0	16.12	0	16.12	0	2.23
8	0	17.58	0	31.36	0	12.32
9	0	21.86	0	22.57	0	3.01
10	0	8.83	0	2.20	0	11.42
11	0	3.64	0	9.65	0	25.26
12	0	48.08	0	51.37	0	38.99
13	0	40.29	0	40.29	0	20.20

Note: Based on data depicted in Map 3-32b. For instance, 40.29 miles of Alternative A are in areas that were used for winter range in 13 of 16 years and 9.88 miles of Alternative A are in areas that were used for high-density winter range in 5 of 16 years.

Table 24. The percent of collared caribou crossing the proposed alignments by time period and season. Based on female caribou outfitted with GPS collars that were active at least 75% of the season and had an average of at least one location per day*.

Season	Time Period	Herd Size	Number of Collar-years[1]	Alternative A	Alternative B	Alternative C
Winter	2010		29	24.1	17.2	6.9
	2011	325,000	29	6.9	6.9	6.9
	2012		33	3.0	3.0	6.1
	2013	235,000	38	2.6	2.6	0.0
	2014		36	0.0	0.0	0.0
	2015		46	0.0	0.0	0.0
	2016	201,000	65	0.0	0.0	3.1
	2017		58	0.0	0.0	1.7
	2018		40	5.0	5.0	5.0
	2019	244,000	38	2.6	2.6	7.9
	2020		54	5.6	0.0	0.0
	2021	188,000	40	22.5	22.5	65.0
	2022	164,000	31	0.0	0.0	0.0

Season	Time Period	Herd Size	Number of Collar-years[1]	Alternative A	Alternative B	Alternative C
	All Years		537	4.8	3.9	7.4
Spring	2010		35	0.0	0.0	0.0
	2011	325,000	43	4.7	2.3	2.3
	2012		42	7.1	7.1	4.8
	2013	235,000	45	0.0	0.0	0.0
	2014		58	0.0	0.0	0.0
	2015		56	0.0	0.0	0.0
	2016	201,000	80	0.0	0.0	0.0
	2017		85	1.2	1.2	0.0
	2018		54	0.0	0.0	1.9
	2019	244,000	53	0.0	0.0	0.0
	2020		64	0.0	0.0	3.1
	2021	188,000	49	0.0	0.0	0.0
	2022	164,000	38	0.0	0.0	0.0
	All Years		702	0.9	0.7	0.9
Late Summer	2010		31	3.2	3.2	3.2
	2011	325,000	36	0.0	0.0	0.0
	2012		35	0.0	0.0	0.0
	2013	235,000	38	0.0	0.0	0.0
	2014		46	4.3	4.3	2.2
	2015		50	0.0	0.0	0.0
	2016	201,000	76	0.0	0.0	0.0
	2017		77	0.0	0.0	0.0
	2018		50	0.0	0.0	0.0
	2019	244,000	44	0.0	0.0	0.0
	2020		64	0.0	0.0	0.0
	2021	188,000	44	0.0	0.0	0.0
	2022	164,000	32	0.0	0.0	0.0
	All Years		623	0.5	0.5	0.3
Fall	2010		29	17.2	24.1	34.5
	2011	325,000	36	5.6	5.6	13.9
	2012		34	0.0	0.0	0.0
	2013	235,000	38	0.0	0.0	0.0
	2014		45	6.7	6.7	8.9
	2015		49	2.0	2.0	2.0
	2016	201,000	72	1.4	0.0	2.8
	2017		74	1.4	1.4	9.5
	2018		46	0.0	0.0	0.0
	2019	244,000	43	2.3	2.3	2.3

Season	Time Period	Herd Size	Number of Collar-years[1]	Alternative A	Alternative B	Alternative C
	2020		62	0.0	0.0	0.0
	2021	188,000	43	9.3	9.3	9.3
	2022	164,000	32	0.0	0.0	6.3
	All Years		603	3.0	3.2	6.0
All Year[2]	2010		29	31.0	27.6	37.9
	2011	325,000	29	17.2	17.2	17.2
	2012		32	3.1	3.1	3.1
	2013	235,000	38	2.6	2.6	0.0
	2014		36	8.3	8.3	8.3
	2015		46	2.2	2.2	2.2
	2016	201,000	64	1.6	1.6	3.1
	2017		57	1.8	1.8	5.3
	2018		39	5.1	5.1	5.1
	2019	244,000	35	2.9	2.9	8.6
	2020		36	5.6	0.0	2.8
	2021	188,000	28	28.6	28.6	67.9
	2022	164,000	22	0.0	0.0	4.5
	All Years		491	7.1	6.5	10.6

1. A collar-year is one collar active for 1 season in 1 year.
2. Years calculated July to June.

2. References*

ABR (ABR, Inc. – Environmental Research & Services, Inc.). 2014a. *Stream Habitat Surveys of Proposed Bridge Crossings on the Brooks East Corridor*. Prepared for DOWL HKM. October 2014.

ABR. 2014b. Landbird and Shorebird Migration, Breeding, and Habitat Use. Study Plan Section 10.16. Initial Study Plan. Susitna-Watana Hydroelectric Project (FERC No. 14241). Prepared for Alaska Energy Authority. February 2014. Anchorage, Alaska. Available at: www.arlis.org/docs/vol1/Susitna2/ISRd/SuWa207sec10-16.pdf.

ABR. 2017. Assessment of Potential Changes in Wetland and Riverine Functions for the Proposed Ambler Mining District Industrial Access Project in Gates of the Arctic National Park, Alaska. Prepared for AIDEA. January, 2017. Anchorage, Alaska.

ACCS (Alaska Center for Conservation Science). 2009. AKNHP Wildlife Conservation Data Portal. Available at: https://biotics.aknhp.axds.co/. Accessed June 22, 2023.

ACCS (Alaska Center for Conservation Science), UAA (University of Alaska Anchorage). 2023. ACCS Rare Plant Data. Obtained July 2023.

ACCS, UAA. 2019. Wildlife Data Portal (Beta). Available at: aknhp.uaa.alaska.edu/apps/wildlife/ Accessed February 25, 2019.

ADF&G (Alaska Department of Fish and Game). 2015. *Alaska Wildlife Action Plan*. Juneau, Alaska.

ADF&G. 2019. Alaska Freshwater Fish Inventory database. ADF&G, Division of Sport Fish. Available at: adfg.maps.arcgis.com/apps/webappviewer/index.html. Accessed March 5, 2019.

ADNR (Alaska Department of Natural Resources), Division of Agriculture. 2019. Invasive Plants and Agricultural Pest Management, Prohibited & Noxious Weeds. Available at: plants.alaska.gov/invasives/noxious-weeds.htm.

AICC (Alaska Interagency Coordination Center). 2019. Alaska Interagency Wildland Fire Management Plan 2016. March 2019 Review. Available at: fire.ak.blm.gov/content/aicc/Alaska%20Statewide%20Master%20Agreement/4.%20Alaska%20Interagency%20WIidland%20Fire%20Managment%20Plan%20(AIWFMP)/2018%20AIWFMP.pdf. Accessed April 24, 2019.

Anderson, D.B., C.L. Brown, R.J. Walker, and K. Elkin. 2004. *Traditional Ecological Knowledge and Contemporary Subsistence Harvest of Non-salmon Fish in the Koyukuk River Drainage, Alaska*. ADF&G, Division of Subsistence. Technical Paper No. 282.

ANHP (Alaska Natural Heritage Program). 2019. Conservation Status Report: Lithobates sylvaticus. Available at: aknhp.uaa.alaska.edu/apps/wildlife/. Accessed February 26, 2019.

AOS (American Ornithological Society). n.d. Checklist of North and Middle American Birds. Available at: checklist.aou.org/taxa/.

Banks, R.C., C. Cicero, J.L. Dunn, A.W. Kratter, H. Ouellet, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising, and D.F. Stotz. 2000. Forty-second supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 117(3):847–858.

Banks, R.C., C. Cicero, J.L. Dunn, A.W. Kratter, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising, and D.F. Stotz. 2002. Forty-third supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 119 (3):897–906.

Banks, R.C., C. Cicero, J.L. Dunn, A.W. Kratter, P.C. Rasmussen, J.V. Remsen Jr., J.D. Rising, and D.F. Stotz. 2003. Forty-fourth supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 120(3):923–931.

BLM (Bureau of Land Management). 2019. BLM-Alaska Special Status Plant and Animal Species List – 2019. Available at: www.blm.gov/programs/fish-and-wildlife/threatened-and-endangered/state-te-data/alaska. Accessed February 14, 2019.

Boucher, T.V., J.R. Fulkerson, B. Bernard, L. Flagstad, T. Nawrocki, M. Carlson, N. Fresco. 2016. Section G. Terrestrial Coarse-filter Conservation Elements. In *Central Yukon Rapid Ecoregional Assessment* (Trammel, E.J, T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, eds.). Prepared for the U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Chesser, R.T., S.M. Billerman, K.J. Burns, C. Cicero, J.L. Dunn, B.E. Hernández-Baños, R.A. Jiménez, A.W. Kratter, N.A. Mason, P.C. Rasmussen, J.V. Remsen, Jr., D.F. Stotz, and K. Winker. 2022. Check-list of North and Middle American Birds. American Ornithological Society. Available at: https://checklist.americanornithology.org/. Accessed June 22, 2023.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Services. Washington, D.C.

DeGroot, K.A., and J. McMillan. 2012. *Landbird Monitoring in the Arctic Network: Gates of the Arctic National Park and Preserve and Noatak National Preserve (2010 Report)*. Natural Resource Data Series NPS/ARCN/NRDS–2012/315. U.S. Department of the Interior, National Park Service, Natural Resource Stewardship and Science. Fort Collins, Colorado.

DOWL. 2012. Wetland Mapping for Preliminary Corridors, Ambler Mining District Access. Prepared for DOT&PF. April 2012. Fairbanks, Alaska.

DOWL. 2014. Preliminary Wetland Delineation and Functions and Values Assessment for the Ambler Mining District Industrial Access Road. Prepared for the AIDEA. May 2014. Anchorage, Alaska.

DOWL. 2016. Desktop Wetland Delineation Ambler Mining District Industrial Access Project. Prepared for AIDEA. June 2016.

DOWL. 2019. Desktop Wetland Delineation Mapping. May 2019. Prepared for AIDEA. Anchorage, Alaska.

Esse, D.A., and C.F. Kretsinger. 2009. Abundance and run timing of adult salmon in Clear Creek, Hogatza River, Alaska, 2000–2005. Program Report DIFR BLM/AK/F0300-65/FY09/1120/07. U.S. Department of the Interior, Bureau of Land Management, Central Yukon Field Office. Fairbanks, Alaska.

Handel, C.M., I.J. Stenhouse, and S.M. Matsuoka, eds. 2021. *Alaska Landbird Conservation Plan, Version 2.0*. Anchorage, Alaska: Boreal Partners in Flight.

Harwood, C. 2023. *Kanuti National Wildlife Refuge Official Bird Checklist*. Available at: https://www.fws.gov/sites/default/files/documents/Kanuti_National_Wildlife_Refuge_Official_Bird_Checklist_Jan_10_2023.pdf. Accessed June 22, 2023.

IUCN (International Union for Conservation of Nature). 2019. The IUCN Red List of Threatened Species. Version 2019-1. Available at: www.iucnredlist.org. Accessed March 22, 2019.

Johnson, J., and B. Blossom. 2018a. Catalog of waters important for spawning, rearing, or migration of anadromous fishes - Interior Region, Effective June 1, 2018. ADF&G, Special Publication No. 18-03. Anchorage, Alaska.

Johnson, J., and B. Blossom. 2018b. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Arctic Region, Effective June 1, 2018. ADF&G, Special Publication No. 18-02. Anchorage, Alaska.

Jones, A. 2006. Iqaluich Nignaqtuat, Fish that we eat. U.S. Fish and Wildlife Service Office of Subsistence Management Fisheries Resource Monitoring Program. Final Report No. FIS02-023. Anchorage, Alaska.

Kretsinger, C.F., S.M. Will, D.R. Hunt, and M.I. Mahran. 1994. Hogatza River *ACEC Aquatic Habitat Management Plan*. BLM-Alaska ACEC HMP BLM/AK/ST-94/014/+6700+070. May 1994.

Lemke, J., J.M. Gottschalk, D. Dissing, R.M. Burgess, and J.C. Seigle. 2013. Anadromous Fish Surveys within the Brooks East Corridor Survey Area, Alaska. Prepared by ABR, Inc. – Environmental Research & Services, June 2013.

Macander, M.J., Nelson, P.R., Nawrocki, T.W., Frost, G.V., Orndahl, K.M., Palm, E.C., Wells, A.F. and Goetz, S.J., 2022. Time-series maps reveal widespread change in plant functional type cover across Arctic and boreal Alaska and Yukon. *Environmental Research Letters* 17(5):054042.

MacDonald, S. O., and J. A. Cook. 2009. *Recent Mammals of Alaska*. University of Alaska Press, Fairbanks, Alaska.

McKenna, B. 2015. Abundance and Run Timing of Adult Salmon in Henshaw Creek, Kanuti National Wildlife Refuge, Alaska, 2014. Tanana Chiefs Conference, Fisheries Program, FRMP 14-209.

NPS (National Park Service). 2019. NPSpecies - The National Park Service biodiversity database. IRMA Portal version. Available at: irma.nps.gov/npspecies. Accessed March 22, 2019.

Ritchie, R. J. 2013. *Raptor Surveys along the Proposed Brooks East Corridor, Ambler Mining District Access Project, Alaska, 2013*. Prepared for DOWL KLM, Anchorage AK by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. Available at: https://ambleraccess.org/Portals/ambler/Content/Reports/Project_Field_Studies/2013/2013_raptor_surveys.pdf. Accessed June 22, 2023.

Scannell, H.L. 2015. Fisheries and Aquatic Inventory of the Koyukuk, John, and Wild Rivers, 2014.

Trammell, E.J., T. Boucher, M.L. Carlson, N. Fresco, J.R. Fulkerson, M.L. McTeague, J. Reimer, and J. Schmidt, eds. 2016. *Central Yukon Rapid Ecoregional Assessment*. Prepared for the U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

USACE (U.S. Army Corps of Engineers). 1987. *Corps of Engineers Wetlands Delineation Manual*. Vicksburg, Mississippi.

USACE. 2007. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)* (Wakeley, J.S., R.W. Lichvar, and C.V. Noble, eds.). ERDC/EL TR-07-24. USACE, Research and Development Center. Vicksburg, Mississippi.

USFWS (U.S. Fish and Wildlife Service). 1995. Photointerpretation Conventions for the National Wetlands Inventory. National Wetland Inventory Center. January 1995.

USFWS. 2008. Birds of Conservation Concern 2008. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, Virginia. Available at: www.fws.gov/migratorybirds/.

Warnock, N. 2017a. Alaska WatchList: 2017 Red List of Declining Bird Populations.

Warnock, N. 2017b. The Alaska WatchList 2017 (yellow list – vulnerable species). Audubon Alaska. Anchorage, Alaska.

Wuttig, K.G., M.L. Albert, A.E. Behr, and J.W. Savereide. 2015. *Fishery Investigations along the Proposed Ambler Road Corridor, 2014*. Fishery Data Series No. 15-37. ADF&G. November 2015.

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1. Affected Environment and Environmental Consequences – Social Systems

1.1. Land Ownership, Use, Management, and Special Designations

1.1.1 Affected Environment

Table 1 lists the communities by class within 50 miles of a project alternative, as well as their Alaska Department of Commerce, Community, and Economic Development (ADCCED) classifications. Volume 4, Maps, Map 3-31 depicts the locations of these communities.

Table 1. Communities by class within 50 miles of a project alternative

Community name	Class	Distance from Alternative A (miles)	Distance from Alternative B (miles)	Distance from Alternative C (miles)
Alatna	Unincorporated	35	35	37
Evansville	Unincorporated	8	8	78
Coldfoot	Unincorporated	13	13	92
Manley Hot Springs	Unincorporated	139	139	41
Tanana	First Class City	128	126	28
Rampart	Unincorporated	105	105	18
Bettles	Second Class City	8	8	77
Allakaket	Second Class City	34	34	39
Ambler	Second Class City	22	22	22
Shungnak	Second Class City	15	15	5
Kobuk	Second Class City	9	9	2
Huslia	Second Class City	92	92	47
Hughes	Second Class City	68	55	3
Wiseman	Unincorporated	24	24	102

Source: ADCCED 2019

Table 2 summarizes 17(b) easements within 5 miles of proposed project alternatives.

Table 2. 17(b) easements within 5 miles of a project alternative

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
9 L	50900613	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
19a C5	50950471	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
4 C5	5020120013	Doyon	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
17, C5, D3, D9, L	5020120013	Doyon, Limited	Existing trail up to 25 feet	No restrictions	Reserved	N/A
30 C5	50950467	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 25 feet	Winter only	Reserved	Alternative A, Alternative B, Alternative C
78 D9	N/A	N/A	N/A	N/A	Nominated	N/A
6 C5	5020110115	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 50 feet	Other	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	No restrictions	Reserved	N/A
7 L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 50 feet	Other	Reserved	Alternative C
15 L	5020110113	NANA Regional Corporation, Inc.	Proposed trail up to 25 feet	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
9 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
10b C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
11 C5	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	Winter only	Reserved	N/A
16 L	5020090323	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
16 L	5020090323	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
50 C5	N/A	N/A	N/A	N/A	Nominated	N/A
9 L	50950689	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
23 C5	5020050403	Doyon, Limited	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
38 E	50950471	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
30 C5	50950469	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
30 C5	50950469	K'oyitl'ots'ina, Limited, Successor in Interest to Hadohdleekaga, Incorporated	Existing trail up to 25 feet	Other	Reserved	N/A
52 C5	N/A	N/A	N/A	N/A	Nominated	N/A
34 C5	50900615	Doyon, Limited	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
1 C3, C5, D9, L	50900615	Doyon, Limited	Existing trail up to 50 feet	Other	Reserved	Alternative A, Alternative B
1 C3, C5, D9, L	5020140025	Evansville, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
1 C3, C5, D9, L	5020120199	Evansville, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
6 C5	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 50 feet	Other	Reserved	N/A
6 C5	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	Other	Reserved	N/A
8 L	5020110113	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
7 L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 50 feet	Other	Reserved	N/A
7 L	5020090323	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing Trail up to 50 feet	Other	Reserved	Alternative A
7 L	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	Other	Reserved	Alternative C
15 L	5020090323	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15 L	5020110113	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15 L	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	N/A
15 L	5020110115	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C
9 C3, D9, L	5020000260	NANA Regional Corporation, Inc.	Road up to 60 feet or greater for existing road	No restrictions	Reserved	Alternative C

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
2 D1	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Existing trail up to 50 feet	No restrictions	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Proposed trail up to 50 feet	No restrictions	Reserved	N/A
2 D1	5020000260	NANA Regional Corporation, Inc.	Existing trail up to 50 feet	No restrictions	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110041	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	Winter only	Reserved	N/A
1 C5, D1	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	Winter only	Reserved	N/A
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
10a C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A

Easement Identification Number	Conveyance	Land owner	Easement type	Use restrictions	Easement status	Alternative intersected
10 C3, D9, L	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Road up to 60 feet or greater for existing road	No restrictions	Reserved	N/A
4 C5, D1, L	5020110041	NANA Corporation, Successor in Interest to Isingnakmeut Incorporated	Existing trail up to 25 feet	No restrictions	Reserved	N/A
4 C5, D1, L	5020110041	NANA Corporation, Successor in Interest to Isingnakmeut Incorporated	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
11 C5	5020110039	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	Winter only	Reserved	N/A
16 L	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	N/A
15 L	5020090323	NANA Corporation, Successor in Interest to Kuuvagmiut Incorporated (also known as Koovukmeut Incorporated in official state and federal documentation)	Proposed trail up to 25 feet	No restrictions	Reserved	N/A
15a C5	N/A	N/A	Proposed trail up to 25 feet	N/A	Nominated	Alternative A, Alternative B
4 C5, D1, L	5020110109	NANA Regional Corporation, Inc.	Existing trail up to 25 feet	No restrictions	Reserved	N/A

Note: N/A = not applicable.

Table 3 summarizes RS2477 trails within 5 miles of proposed project alternatives.

Table 3. RS2477 trails within 5 miles of a project alternative

ADNR Casefile number	Name	Qualifies as RS2477 right-of-way	Alternative intersected
RST 18	Bettles-Wild Lake River Trail	Yes	Alternative A, Alternative B
RST 38	Tramway Bar	Yes	Alternative A, Alternative B
RST 105	Alatna-Shungnak	Yes	Alternative C
RST 209	Bettles-Coldfoot	Yes	Alternative A, Alternative B
RST 289	Tanana-Allakaket	Yes	Alternative C
RST 308	Hughes-Mile 70	Yes	Alternative C
RST 412	Slate Creek	Yes	Alternative A, Alternative B
RST 450	Hickel Highway	Yes	Alternative A, Alternative B
RST 1611	Bergman-Castle Mountain	Yes	Alternative A, Alternative B
RST 1718	Kobuk-Dahl Creek Trail	Yes	N/A
RST 1719	Wesley Creek Trail	Yes	Alternative C
RST 1720	Dahl Creek-Wesley Creek Trail	Yes	Alternative C
RST 1741	California Creek Trail	Yes	N/A
RST 1742	Kobuk River-California Creek Mine	Yes	N/A
RST 1744	Kobuk River-Junction	Yes	Alternative C
RST 1745	Kobuk-Dahl Creek Landing Field	Yes	N/A
RST 1913	Pah River Portage	Yes	Alternative C

Source: ADNR 2019

Note: ADNR = Alaska Department of Natural Resources; N/A = not applicable; RS = Revised Statute; RST = Revised Statute Trail.

Table 4 shows the Bureau of Land Management (BLM) Areas of Critical Environmental Concern (ACEC) and Research Natural Areas (RNA) near the project, including their size and reason for ACEC/RNA designation. Volume 4, Map 3-26 depicts the locations of areas.

Table 4. BLM Areas of Critical Environmental Concern and Research Natural Areas in the project vicinity

Plan	ACEC or RNA name	Size (acres)	Reason for designation
CY	Hogatza River Tributaries ACEC	5,200	Crucial salmon spawning habitat
CY	Indian River ACEC	158,000	Crucial salmon spawning habitat
CY	Ishtalitna Creek Hot Springs RNA	1,000	Low-gradient hot springs system
UC	Kanuti Hot Springs ACEC	40	Hot springs system
CY	Lake Todatonten Pingos RNA	660	Geologic features: open system pingos
CY	McQuesten Creek RNA	3,900	Low-gradient hot springs system; geologic features: stone stripes and surface slumps
CY	South Todatonten Summit RNA	660	Geologic features: open system pingos
CY	Spooky Valley RNA	10,100	Geologic, physiographic, vegetation, and scenic
CY	Tozitna River ACEC	843,000	Crucial salmon spawning habitat

Plan	ACEC or RNA name	Size (acres)	Reason for designation
CY	Tozitna Subunit North ACEC	129,000	Crucial caribou calving habitat
CY	Tozitna Subunit South ACEC	62,600	Crucial caribou calving habitat

Sources: BLM 1991, 2012
Note: ACEC = Areas of Critical Environmental Concern; CY = Central Yukon; RNA = Research Natural Area; UC = utility corridor.

1.1.2 Environmental Consequences

Table 5 shows the amount of land by owner that would be within the project right-of-way for each of the three alternatives.

Table 5. Acreage of land by owner within the right-of-way by alternative

Land Owner	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)
Department of the Interior	3,498	3,082	19,089
State government	8,635	10,147	426
Local government	261	592	0
Native Allotment	Less than 1	Less than 1	12
Alaska Native lands patented or interim conveyed	2,439	2,437	3,389
Private	0	0	152
Undetermined	42	45	73
Total	14,873	16,305	23,142

Note: The right-of-way is generally 250 feet wide, centered on the road centerline, except where the toe-of-slope is outside that limit. In those locations, the right-of-way boundary is considered to be 10 feet beyond the toe-of-slope limit.

To give a sense of how much each action alternative affects land areas with special management designations, Table 6 provides the linear miles of each alignment within such designated areas.

Table 6. Mileage of each alternative within affected special designation areas

Designation area	Alternative A (miles)	Alternative B (miles)	Alternative C (miles)
BLM Utility Corridor Special Recreation Management Area	3.1	3.1	3.1
National Wilderness Preservation System	0	0	0
National Park System (GAAR)	26.1	17.8	0
National Wildlife Refuge System	0	0	0
Wild and Scenic River System[a] (Kobuk River)	River crossed	River crossed	River not crossed
Tozitna River ACEC (BLM)	0	0	77.2
Indian River ACEC (BLM)	0	0	24.4
Other Lands (not specially designated)	182.0	207.5	227.6

Note: ACEC = Areas of Critical Environmental Concern; BLM = Bureau of Land Management; GAAR = Gates of the Arctic National Park and Preserve.
[a] Wild and Scenic Rivers within GAAR do not have a separate land area designation or width; therefore, this table indicates whether an alternative crosses or does not cross the Kobuk Wild and Scenic River, but it does not show mileage.

1.2. Transportation and Access

1.2.1 Affected Environment

Table 7 provides information on transportation facilities within the study area by community, including details on road accessibility and barge service, as well as the closest airport. Volume 4, Map 3-27 depicts the locations of these community transportation facilities.

Table 7. Community-based transportation facilities within the transportation study area

Community name	Connected to road system?	Closest airport	Commercial barge service[a]
Alatna	No	Allakaket Airport	No
Evansville	Seasonal	Bettles Airport	No
Coldfoot	Yes	Coldfoot Airport	No
Manley Hot Springs	Yes	Manley Hot Springs	Yes
Tanana	Seasonal	Tanana Ralph M Calhoun Airport	Yes
Rampart	Seasonal	Rampart Airport	Yes
Bettles	Seasonal	Bettles Airport	No
Allakaket	No	Allakaket Airport	No
Ambler	No	Ambler Airport	Not consistent service
Shungnak	No	Shungnak Airport	Not consistent service
Kobuk	No	Kobuk Airport	Not consistent service
Huslia	No	Huslia Airport	Yes
Hughes	No	Hughes Airport	Not consistent service
Wiseman	Yes	Wiseman Airport[b]	No

Source: ADCCED 2019
[a] Under typical conditions.
[b] Not consistently maintained.

1.2.2 Environmental Consequences

No additional tables or supplemental information.

1.3. Recreation and Tourism*

1.3.1 Affected Environment

Table 8 presents the rivers commonly used for float trips that could be affected by the project. It also includes the common float lengths, typical craft used, put-in and take-out locations, and details on the lands crossed. Volume 4, Map 3-26 depicts the locations of these river float routes. Those listed in Table 8 are examples of rivers made prominent because segments of them start within GAAR or they otherwise have segments that have been designated as parts of the national Wild and Scenic Rivers System. Most named streams can be floated, particularly with the advent of lightweight, single-person packrafts that can be combined with hiking. Float trips have been reported in public comments on the Draft Environmental Impact Statement (EIS) and online as occurring on Beaver Creek, Iniakuk River, Kogoluktuk River, Koyukuk River, Malamute Fork of the John River, Malamute Fork of the Alatna River, Mauneluk River, Reed River, Shungnak River, Wild River, and others. Note that put-in and take-out locations are limited to what is accessible by small aircraft (e.g., Super Cub landing on small gravel bars).

Table 8. Potentially affected common river float routes*[a]

River name (common float length)	Typical craft[b]	Typical put-in location[c]	Typical take-out location	Lands crossed
Alatna River (135 miles)	Inflatable kayak, raft	Circle Lake	Allakaket (Koyuk confluence), Malamute Fork (gravel bar), Helpmejack Creek	GAAR (WSR), state, BLM, Native corporation
Ambler River (75 miles)	Canoe, kayak	Gravel bars near headwaters	Ambler Village	GAAR, state, BLM, Native corporation
John River (100 miles)	Canoe, kayak, raft	Hunt Fork Lake	Bettles/Koyukuk confluence	GAAR (WSR), state, Native corporation
Kobuk River (115 miles)	Kayak, raft	Walker Lake	Kobuk	GAAR (WSR), state, Native corporation, BLM
North Fork Koyukuk River (90 miles)	Kayak, raft	Kuchona Creek, Redstar Creek	Bettles	GAAR (WSR), Native corporation, state
Selawik River (160 miles)	Canoe, kayak	Lake near headwaters	Selawik River (floatplane) below Tagagawik River	Selawik NWR (WSR)
Wild River (63 miles)	Canoe, kayak, raft	Wild Lake (put-in by plane from Bettles)	Bettles (left-hand shore)	State, Native corporation

Sources: Alaska.org n.d.; American Packrafting Association n.d.; U.S. Fish and Wildlife Service n.d.

Note: BLM = Bureau of Land Management; GAAR = Gates of the Arctic National Park and Preserve; NWR = National Wildlife Refuge; State = State of Alaska; WSR = Wild and Scenic River.

[a] Many other streams may be floated, particularly by single-person packraft in conjunction with hiking, and some of them could be affected by the project.

[b] This table shows craft for typical recreational float trips. Larger craft, including barges, are able to use portions of these rivers. This table is not meant to address navigability determinations.

[c] Typical access to put-in location is by small plane from Bettles or Coldfoot or direct from Fairbanks.

1.3.2 Environmental Consequences

See Table 8. Impacts to the recreational user would be similar to those discussed in the EIS for any stream or river crossed by an alternative.

1.4. Visual Resources

1.4.1 Affected Environment

No tables or supplemental information.

1.4.2 Environmental Consequences

Table 9 presents the mileage of each action alternative within BLM Visual Resource Management (VRM) classifications. BLM has only designated VRM classifications near the Dalton Highway corridor.

Table 9. Mileage of each action alternative within BLM's Visual Resource Management classes

BLM VRM class	Alternative A (miles)[a]	Alternative B (miles)[a]	Alternative C (miles)[a]
Class I/II	0	0	0
Class III	16.9	16.9	7.9
Class IV	1.9	1.9	4.4

Source: BLM data accessed 2019; analysis by HDR

Note: BLM = Bureau of Land Management; VRM = Visual Resource Management.

[a] Mileages are short compared to the overall lengths of the alternatives because BLM VRM classes exist only near the Dalton Highway. Mileage given is on the centerline of each alternative and does not include proposed access roads to material sites, maintenance camps, or other associated facilities.

Table 10 presents the mileage of each action alternative with BLM Visual Resource Inventory (VRI) classifications. These occur more broadly, including some areas not managed by the BLM, but are a tool for inventorying the importance of the visual environment on BLM-managed lands and do not indicate management intent.

Table 10. Mileage of each alternative within BLM's Visual Resource Inventory classes

BLM VRI class	Alternative A (miles)	Alternative B (miles)	Alternative C (miles)
Class I	0	0	0
Class II	107.3	119.3	75.5
Class III	0	0	64.4
Class IV	21.5	25.7	168.7
Unclassified (GAAR[a])	26.1	17.8	0
Unclassified (other[a])	56.4	65.6	23.9

Source: BLM data accessed 2019, analysis by HDR

Note: BLM= Bureau of Land Management; GAAR = Gates of the Arctic National Park and Preserve; VRI = Visual Resource Inventory.

[a] The BLM has classified broad areas of similar topography and vegetation regardless of land ownership but has not classified the entire project area. Gates of the Arctic National Park and Preserve is assumed to be the equivalent of Class I or II based primarily on management intent. Based on surrounding classifications (see Volume 4, Map 3-30), the other unclassified portions would likely be a combination of classes II, III, and IV, with more Class II near the Brooks Range and more Class IV farther south. Mileage given is on the centerline of each alternative and does not include proposed access roads to material sites, maintenance camps, or other facilities that may occur.

1.5. Socioeconomics and Communities*

1.5.1 Affected Environment

Table 11 presents the most current employment data available for the Northwest Arctic Borough (NAB) and the Yukon-Koyukuk Census Area (YKCA) by industry, based on data from the Alaska Department of Labor and Workforce Development, Quarterly Census of Employment and Wages (QCEW 2022). Local government jobs constitute the largest employment sector in the NAB and YKCA, accounting for 33 percent and 65 percent of total jobs in the region, respectively. The selected industries in the private sector are based on the highest employment sectors in each of the regions. In the NAB, top employment sectors in terms of number of jobs include mining, health services, transportation, and leisure and hospitality. In the YKCA region, private sector jobs are highest in trade, transportation and utilities, health services, and other services which includes jobs in membership organizations. There are 78 businesses operating (private sector) in the NAB region and 117 in the YKCA region. The highest-paying private sector jobs are in mining and construction, while state government jobs pay the highest in the public sector.

Volume 4, Map 3-31 depicts the boundaries of these analysis areas.

Table 11. Northwest Arctic Borough and Yukon-Koyukuk Census Area Annual Average Employment, Average Monthly Wages, and Number of Entities by Industry 2022*[a]

Sector	Number of Jobs	Percent	Average Monthly Wages	Number of Entities
Northwest Arctic Borough				
Private Sector	1,735	64%	$7,917	78
Natural Resources and Mining	655	24%	$10,595	3

Sector	Number of Jobs	Percent	Average Monthly Wages	Number of Entities
Health Services	500	18%	$7,070	13
Trade, Transportation and Utilities	260	10%	$4,813	24
Leisure and Hospitality	113	4%	$4,421	9
Professional and Business Services	39	1%	$7,160	5
Financial Activities	37	1%	$5,116	4
Information	37	1%	$5,347	4
Other Sectors	94	3%		16
Public Sector	995	36%	$4,580	91
Federal Government	48	2%	$6,177	15
State Government	57	2%	$8,607	26
Local Government	890	33%	$4,236	50
Total	2,730	100%	$6,701	169
Yukon Kuskokwim Census Area				
Private Sector	640	29%	$4,788	117
Trade, Transportation and Utilities	185	8%	$4,425	49
Health Services	173	8%	$4,910	8
Other services	123	6%	$4,538	10
Construction	42	2%	$9,017	8
Professional and Business Services	42	2%	$4,770	8
Leisure and Hospitality	39	2%	$2,019	12
Natural Resources and Mining	18	1%	$8,295	11
Other Sectors	18	1%		11
Public Sector	1,581	71%	$3,444	146
Federal Government	64	3%	$4,799	27
State Government	84	4%	$6,827	52
Local Government	1,433	65%	$3,186	67
Total	**2,220**		**$3,833**	**263**

Source: ADOLWD 2023 (2022 QCEW data)
[a] Data are by place of work and includes both resident and non-resident employment in the region. The ADOLWD QCEW database captures data for workers in private sector, state, and local government covered by unemployment insurance within Alaska. Federal workers, military, and the self-employed are not included. Local government data includes municipal government, local school district, and tribal government.

Table 12 presents the latest available data on electricity rates (fiscal year 2022), with and without the State of Alaska's Power Cost Equalization (PCE) program, and average prices of gasoline and heating fuel in selected communities. Data on average prices of gasoline and heating fuel are only available for or selected communities that participate in the Communities' Fuel Price Survey conducted by the ADCCED. The table also includes the average heating fuel price paid by the power utility in each of the communities. Note that the utility pays a discounted price based on volume deliveries negotiated by the utilities.

Volume 4, Map 3-31 depicts the locations of these communities.

Table 12. Heating oil, gasoline, and electricity prices in study area communities

Community	FY 2022 residential electricity rate without PCE	FY 2022 residential electricity rate with PCE	FY 2022 Average price of diesel fuel (paid by utility)	2022 average price for gasoline	2022 average price for heating fuel
	per kWh	per kWh	per gallon	per gallon	per gallon
Alatna	$1.02	$0.33	$5.27	$9.50	$8.00
Allakaket	$1.02	$0.33	$5.27	$9.50	$8.00
Bettles	$0.75	$0.32	$3.24	N/A	N/A
Evansville	$0.75	$0.32	$3.24	N/A	N/A
Hughes	$0.71	$0.20	$4.84	$11.00	$11.00
Huslia	$0.56	$0.25	$3.08	$6.00	$6.25
Rampart	$0.81	$0.33	$3.34	N/A	N/A
Ambler	$0.84	$0.27	$4.08	N/A	N/A
Kobuk	$0.90	$0.27	$5.28	N/A	N/A
Shungnak	$0.90	$0.27	$5.28	N/A	N/A

Source: FY 2022 PCE report (Alaska Energy Authority 2023); Fuel Price Survey 2022 Data (ADCCED 2023)
Note: FY = fiscal year, N.A = not applicable; PCE = Power Cost Equalization.

Table 13. Unemployment rates in study area region*

Community	2019	2020	2021	2022
Northwest Arctic Borough	13	12.7	11.5	9
Yukon Koyukuk Census Area	13.1	12.7	12.3	9
Alaska (Statewide)	5.6	8.3	6.4	4

Source: FY 2022 PCE report (Alaska Energy Authority 2023); Fuel Price Survey 2022 data (ADCCED 2023)

1.5.2 Environmental Consequences

Table 14. Summary of project construction costs for the 4 projects (2020 dollars)

Project	Total expenditures	In-state expenditures
Arctic	$827.1 million	$199.48 million
Bornite	$2.14 billion	$516.48 million
Smucker	$212.68 million	$51.3 million
Sun	$414.11 million	$99.88 million

Source: UA 2019 (based on IMPLAN modeling)

Table 15. Summary of economic inputs for the 4 projects (2020 dollars)

Inputs	Arctic	Bornite	Smucker	Sun
Life of mine resource value	$10.4 billion	$13.2 billion	$1.1 billion	$1.6 billion
Operating life (years)	12	21	5	6

Inputs	Arctic	Bornite	Smucker	Sun
Annual revenues	$866,454,417	$626,519,511	$218,834,200	$261,535,679
Annual direct labor costs	$31,646,523	$22,883,101	$7,992,736	$9,552,372
Annual direct operations employment	217	157	55	66

Source: UA2019 (based on IMPLAN modeling)

Table 16. Summary of average annual economic effects of mining project construction (statewide) (2020 dollars)

Project	Labor income ($) direct	Labor income ($) indirect and induced	Labor income ($) total	Employment (jobs) direct	Employment (jobs) indirect and induced	Employment (jobs) total
Arctic	47,557,121	17,859,830	65,416,951	461	338	799
Bornite	184,700,512	69,363,316	254,063,828	1,792	1,312	3,104
Sun	35,717,177	13,413,400	49,130,577	346	254	600
Smucker	18,343,876	6,888,947	25,232,823	178	130	308

Source: UA 2019 (based on IMPLAN modeling)

Table 17. Summary of average annual economic effects of mining project operations (statewide) (2020 dollars)

Project	Labor income ($) direct	Labor income ($) indirect and induced	Labor income ($) total	Employment (jobs) direct	Employment (jobs) indirect and induced	Employment (jobs) total
Arctic	31,646,523	95,749,592	127,396,115	217	1,446	1,663
Bornite	22,883,100	87,137,262	110,020,362	157	1,296	1,453
Sun	9,552,372	26,279,700	35,832,072	66	404	469
Smucker	7,992,735	18,367,958	26,360,693	55	291	346

Source: UA 2019 (based on IMPLAN modeling)

Table 18. Example Minimum Annual Assessment and resulting payments to (2020 dollars)

Example	Principal	Interest rate	Term	Total payment	Annual payment
Ambler Road Bond	$412 million	5%	30 years	$797.4 million	$26.6 million
MAA	$412 million	6.5%	50 years	$1.4 billion	$27.9 million

Source: AIDEA (Tappen 2019)

Table 19. State government revenue from mine projects (2020 dollars)

Revenue item	Arctic	Bornite	Sun	Smucker	Total
State claim rental	$10,200,165	Not applicable	$3,053,324	$123,299	$13,376,788
State mining license fee	$155,961,798	$197,353,646	$23,538,211	$16,412,568	$393,266,222

Revenue item	Arctic	Bornite	Sun	Smucker	Total
State corporate income tax	$207,949,063	$263,138,195	$31,384,281	$21,883,423	$524,354,963
State royalty	$178,509,223	Not applicable	$20,361,998	$14,915,933	$213,787,154
Fuel tax	$264,000	$1,219,078	$71,721	$47,813	$1,602,612
Total	$552,620,250	$460,491,841	$78,337,815	$53,335,223	$1,144,785,127

Source: UA 2019

Table 20. Local government revenue from mine projects (2020 dollars)

Project	Payment in lieu of taxes	Village improvement fund	Total
Arctic	$27,602,196	$28,284,693	$55,886,889
Bornite	$70,783,545	$40,057,657	$110,841,202
Sun	$10,555,441	$4,268,809	$14,824,250
Smucker	$8,918,501	$2,976,527	$11,895,027
Total	$117,859,683	$75,587,685	$193,447,368

Source: UA 2019

1.6. Environmental Justice*

1.6.1 Affected Environment

President William J. Clinton issued Executive Order (EO) 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, in 1994. Its purpose is to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities. The EO directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations to the greatest extent practicable and permitted by law. EO 12898 was supplemented by EO 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All, April 26, 2023, which directs federal agencies, as appropriate and consistent with applicable law, to identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of Federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns.

When determining whether effects are disproportionately high and adverse, EO 12898 directs agencies to consider the following:

1. Whether there is, or will be, an effect on the natural or physical environment that significantly (as employed by the National Environmental Policy Act [NEPA]) and adversely affects a minority or low-income population or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority or low-income communities or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment;
2. Whether environmental effects are significant (as employed by NEPA) and are, or may be, having an adverse impact on minority or low-income populations or Indian tribes that appreciably exceeds, or is likely to appreciably exceed, those on the general population or other appropriate comparison group; and

3. Whether the environmental effects occur, or would occur, in a minority or low-income population or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

This analysis identified minority and low-income populations in study area communities using the 2017-2021 American Community Survey 5-year data provided by the U.S. Census Bureau (2023). The analysis based minority status determinations on identifying individuals who are non-white, or who are white but have Hispanic ethnicity. The analysis based low-income status determinations on identifying individuals living in poverty in the previous 12 months.

This analysis identified a study area community as an environmental justice (EJ) community if (1) the minority population exceeds 50 percent or (2) the minority or low-income population is meaningfully greater than the minority or low-income population percentage in a reference population. For the purposes of this analysis, the reference population is the population of Alaska. The decision threshold when there is a "meaningfully greater" percentage of minority or low-income individuals than in the reference population is based on the following equation:

(minority or low-income population in study area community/total population in study area community)

divided by

(minority or low-income population in reference area/total population in reference area).

If the equation results in a number greater than 1, there is a greater proportion of minority or low-income individuals residing in the study area community than in the reference population.

Table 21 presents population, minority, and low-income characteristics of study area communities and other geographic extents such as relevant boroughs and Alaska as a whole. The communities that did not meet the criteria for an EJ community include Coldfoot, Wiseman, and Bettles. Volume 4, Map 3-31 depicts the locations of these census areas and communities.

See Table 21 and Table 22.

1.6.2 Environmental Consequences

See Table 22.

Table 21. Population and environmental justice metrics in study area communities*

Geographic location	Associated with Alaska Native tribe	Total population	Minority population metric: White (%)[a]	Minority population metric: Black or African American (%)[b]	Minority population metric: American Indian or Alaska Native (%)[b]	Minority population metric: Asian (%)[b]	Minority population metric: Pacific Islander (%)[b]	Minority population metric: Other (%)[b]	Minority population metric: Hispanic or Latino (%)[c]	Minority population metric: minority (%)[d]	Minority population metric: EJ community?	Low-income population metric: unemployment rate (%)	Low-income population metric: median household income ($)	Low-income population metric: individuals below poverty level (%)	Low-income population metric: EJ community?
State of Alaska	N/A	733,391	59.4%	4.8%	21.9%	8.4%	2.5%	2.5%	6.8%	40.6%	N/A	6.9%	80,287	10.4%	N/A
Fairbanks North Star Borough	N/A	95,655	69.0%	6.4%	14.1%	5.4%	1.1%	2.3%	7.7%	31.0%	N/A	6.3%	78,321	6.4%	N/A
Fairbanks	No	32,515	57.8%	11.6%	17.3%	7.0%	1.8%	3.3%	11.4%	42.2%	Yes	8.1%	66,572	9.1%	No
Nome Census Area	N/A	10,046	14.2%	1.2%	82.6%	2.2%	0.4%	0.6%	1.9%	85.8%	N/A	18.6%	63,977	21.9%	N/A
Brevig Mission	Yes	428	5.6%	0.7%	91.8%	1.4%	0.9%	0.9%	1.2%	94.4%	Yes	25.6%	55,078	60.8%	Yes
Elim	Yes	366	4.9%	0.3%	92.9%	0.8%	0.0%	0.5%	1.4%	95.1%	Yes	47.7%	40,750	37.4%	Yes
Golovin (Cheenik)	Yes	175	6.3%	0.0%	93.7%	0.0%	0.0%	0.0%	0.6%	93.7%	Yes	15.2%	54,375	12.9%	Yes
Koyuk	Yes	312	3.8%	0.3%	94.9%	2.2%	0.0%	0.0%	1.3%	96.2%	Yes	23.5%	33,438	35.7%	Yes
Nome	Yes	3,699	26.5%	2.2%	67.3%	4.2%	0.5%	1.1%	3.2%	73.5%	Yes	10.7%	91,375	7.3%	No
St. Michael	Yes	456	5.5%	1.3%	93.4%	0.7%	0.9%	0.0%	0.7%	94.5%	Yes	37.5%	37,188	19.0%	Yes
Shaktoolik	Yes	212	9.4%	2.8%	88.2%	0.5%	0.0%	0.0%	0.5%	90.6%	Yes	34.8%	58,500	12.1%	Yes
Shishmaref	Yes	576	2.6%	0.9%	96.7%	0.2%	0.0%	0.0%	0.0%	97.4%	Yes	25.8%	53,182	32.0%	Yes
Stebbins	Yes	634	4.9%	0.6%	94.2%	0.3%	0.3%	0.2%	0.8%	95.1%	Yes	28.1%	50,750	26.9%	Yes
Teller	Yes	249	3.6%	0.0%	94.0%	2.4%	0.4%	0.0%	0.8%	96.4%	Yes	14.8%	32,083	42.0%	Yes
Unalakleet	Yes	765	14.5%	0.1%	84.1%	1.2%	0.0%	0.5%	0.9%	85.5%	Yes	8.8%	83,750	10.3%	No
Wales	Yes	168	6.5%	0.0%	89.9%	1.8%	1.2%	0.6%	1.8%	93.5%	Yes	14.6%	33,125	34.7%	Yes
White Mountain	Yes	185	6.5%	0.0%	93.5%	0.0%	0.0%	0.0%	0.0%	93.5%	Yes	28.1%	48,125	28.6%	Yes
North Slope Borough	N/A	11,031	27.9%	2.3%	57.8%	7.0%	4.1%	1.1%	5.0%	72.1%	N/A	9.2%	83,992	8.6%	N/A
Anaktuvuk Pass	Yes	425	16.7%	0.7%	82.6%	0.9%	0.9%	0.0%	1.6%	83.3%	Yes	19.8%	62,788	35.5%	Yes
Atqasuk	Yes	276	7.6%	0.4%	91.7%	0.4%	0.4%	0.0%	0.4%	92.4%	Yes	11.3%	91,875	23.8%	Yes
Utqiaġvik	Yes	4,927	14.1%	2.7%	63.5%	14.5%	8.3%	0.6%	3.5%	85.9%	Yes	13.1%	93,661	8.2%	No
Nuiqsut	Yes	512	6.8%	0.2%	93.0%	0.2%	0.0%	0.0%	0.0%	93.2%	Yes	15.2%	68,393	6.7%	No
Point Hope	Yes	830	7.1%	1.7%	92.2%	0.0%	0.0%	0.0%	0.4%	92.9%	Yes	30.3%	62,321	19.0%	Yes
Point Lay	Yes	330	5.8%	0.0%	93.9%	0.0%	0.3%	0.0%	0.3%	94.2%	Yes	15.5%	78,750	20.1%	Yes
Wainwright	Yes	628	3.3%	0.8%	95.9%	0.2%	0.2%	0.0%	0.5%	96.7%	Yes	13.1%	84,000	8.4%	No
Northwest Arctic Borough	N/A	7,793	9.0%	1.7%	88.1%	1.5%	0.5%	0.3%	1.3%	91.0%	N/A	15.7%	68,654	20.5%	N/A
Ambler	Yes	274	6.2%	3.3%	91.2%	1.5%	0.7%	0.0%	0.7%	93.8%	Yes	25.3%	35,750	22.7%	Yes
Buckland	Yes	550	1.1%	0.5%	98.0%	0.5%	0.2%	0.0%	0.4%	98.9%	Yes	33.3%	51,923	14.3%	Yes
Deering	Yes	182	3.3%	0.5%	95.1%	1.1%	0.5%	0.0%	0.0%	96.7%	Yes	20.3%	44,375	17.2%	Yes

Geographic location	Associated with Alaska Native tribe	Total population	Minority population metric: White (%)[a]	Minority population metric: Black or African American (%)[b]	Minority population metric: American Indian or Alaska Native (%)[b]	Minority population metric: Asian (%)[b]	Minority population metric: Pacific Islander (%)[b]	Minority population metric: Other (%)[b]	Minority population metric: Hispanic or Latino (%)[c]	Minority population metric: minority (%)[d]	Minority population metric: EJ community?	Low-income population metric: unemployment rate (%)	Low-income population metric: median household income ($)	Low-income population metric: individuals below poverty level (%)	Low-income population metric: EJ community?
Kiana	Yes	447	4.7%	1.1%	94.4%	0.7%	0.0%	0.0%	0.2%	95.3%	Yes	30.7%	58,000	25.0%	Yes
Kivalina	Yes	444	1.8%	0.2%	98.2%	0.0%	0.0%	0.0%	0.2%	98.2%	Yes	17.3%	59,688	26.6%	Yes
Kobuk	Yes	191	10.5%	2.6%	86.9%	1.6%	0.5%	0.0%	2.6%	89.5%	Yes	20.4%	29,688	35.9%	Yes
Kotzebue	Yes	3,102	16.3%	3.1%	77.7%	2.8%	0.7%	0.6%	2.5%	83.7%	Yes	5.8%	95,385	14.8%	Yes
Noatak	Yes	570	4.4%	0.5%	95.1%	0.2%	0.4%	0.0%	0.4%	95.6%	Yes	32.5%	56,667	5.7%	No
Noorvik	Yes	694	2.2%	0.3%	97.8%	0.1%	0.4%	0.0%	0.0%	97.8%	Yes	31.7%	51,563	22.0%	Yes
Selawik	Yes	809	2.0%	0.0%	98.0%	0.0%	0.2%	0.0%	0.0%	98.0%	Yes	24.0%	43,000	48.5%	Yes
Shungnak	Yes	272	2.2%	0.0%	96.7%	1.5%	0.4%	0.0%	0.4%	97.8%	Yes	33.3%	60,938	31.5%	Yes
Kusilvak Census Area	N/A	8,368	2.1%	0.6%	96.9%	0.5%	0.3%	0.2%	0.2%	97.9%	N/A	24.7%	37,975	36.6%	N/A
Alakanuk	Yes	756	2.6%	0.3%	95.8%	0.3%	0.4%	1.3%	0.3%	97.4%	Yes	30.5%	36,429	42.8%	Yes
Emmonak	Yes	825	2.8%	0.8%	96.2%	0.7%	0.4%	0.0%	0.2%	97.2%	Yes	23.7%	42,321	19.3%	Yes
Kotlik	Yes	655	0.2%	0.0%	99.8%	0.0%	0.2%	0.0%	0.0%	99.8%	Yes	19.0%	47,833	34.2%	Yes
Marshall	Yes	492	1.6%	0.6%	97.6%	0.0%	0.4%	0.2%	0.2%	98.4%	Yes	23.1%	40,625	45.0%	Yes
Mountain Village	Yes	621	3.1%	1.1%	95.2%	0.6%	0.3%	0.2%	0.0%	96.9%	Yes	22.6%	34,583	42.5%	Yes
Nunam Iqua	Yes	217	0.9%	0.9%	97.7%	0.0%	0.9%	0.0%	0.5%	99.1%	Yes	44.0%	33,750	81.3%	Yes
Pilot Station	Yes	615	1.3%	0.7%	97.7%	0.5%	0.2%	0.0%	0.0%	98.7%	Yes	31.9%	27,000	52.9%	Yes
Pitkas Point	Yes	120	0.0%	0.8%	100.0%	0.0%	0.8%	0.0%	0.0%	100.0%	Yes	22.2%	53,438	50.8%	Yes
Russian Mission	Yes	421	1.7%	0.2%	98.1%	0.0%	0.0%	0.0%	0.0%	98.3%	Yes	6.5%	–	28.8%	Yes
St. Mary's	Yes	599	4.2%	0.3%	95.0%	0.7%	0.5%	0.0%	0.3%	95.8%	Yes	17.8%	41,875	29.6%	Yes
Yukon-Koyukuk Census Area	N/A	5,343	21.1%	0.8%	77.2%	0.9%	0.4%	0.5%	1.3%	78.9%	N/A	12.8%	43,405	23.2%	N/A
Alatna	Yes	15	6.7%	0.0%	93.3%	0.0%	0.0%	0.0%	0.0%	93.3%	Yes	0.0%	46,250	12.2%	Yes
Allakaket	Yes	177	11.3%	0.0%	87.6%	1.1%	0.0%	0.0%	0.0%	88.7%	Yes	20.8%	22,000	59.2%	Yes
Anvik	Yes	70	4.3%	1.4%	94.3%	0.0%	0.0%	0.0%	0.0%	95.7%	Yes	18.8%	51,250	24.7%	Yes
Beaver	Yes	48	2.1%	0.0%	95.8%	2.1%	0.0%	0.0%	2.1%	97.9%	Yes	9.3%	33,036	24.4%	Yes
Bettles	No	23	73.9%	0.0%	26.1%	0.0%	0.0%	0.0%	4.3%	26.1%	No	–	–	0.0%	No
Coldfoot	No	34	64.7%	0.0%	14.7%	8.8%	2.9%	5.9%	11.8%	35.3%	No	0.0%	–	0.0%	No
Evansville	Yes	12	50.0%	0.0%	41.7%	0.0%	0.0%	8.3%	8.3%	50.0%	Yes	0.0%	82,083	0.0%	No
Galena	Yes	472	24.2%	0.0%	73.5%	1.3%	0.0%	1.5%	0.8%	75.8%	Yes	8.0%	76,250	16.0%	Yes
Grayling	No	210	2.4%	0.0%	97.6%	0.0%	1.0%	0.0%	0.5%	97.6%	Yes	20.6%	32,500	30.1%	Yes
Holy Cross	Yes	176	4.0%	0.0%	96.0%	0.0%	0.0%	0.0%	1.1%	96.0%	Yes	16.2%	30,833	16.2%	Yes
Hughes	Yes	85	5.9%	0.0%	92.9%	1.2%	0.0%	0.0%	1.2%	94.1%	Yes	16.7%	21,250	36.6%	Yes
Huslia	Yes	304	4.3%	0.0%	95.4%	0.7%	0.7%	0.0%	1.3%	95.7%	Yes	29.8%	44,375	28.3%	Yes
Kaltag	Yes	158	7.0%	0.0%	93.0%	0.0%	0.0%	0.0%	0.0%	93.0%	Yes	27.7%	28,750	11.1%	Yes

Geographic location	Associated with Alaska Native tribe	Total population	Minority population metric: White (%)[a]	Minority population metric: Black or African American (%)[b]	Minority population metric: American Indian or Alaska Native (%)[b]	Minority population metric: Asian (%)[b]	Minority population metric: Pacific Islander (%)[b]	Minority population metric: Other (%)[b]	Minority population metric: Hispanic or Latino (%)[c]	Minority population metric: minority (%)[d]	Minority population metric: EJ community?	Low-income population metric: unemployment rate (%)	Low-income population metric: median household income ($)	Low-income population metric: individuals below poverty level (%)	Low-income population metric: EJ community?
Koyukuk	Yes	98	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1.0%	100.0%	Yes	14.7%	20,893	17.5%	Yes
Livengood	No	16	68.8%	0.0%	25.0%	6.3%	0.0%	0.0%	0.0%	31.2%	No	0.0%	–	55.6%	Yes
Manley Hot Springs	Yes	169	30.8%	1.8%	67.5%	2.4%	0.0%	0.6%	1.8%	69.2%	Yes	0.0%	–	0.0%	No
Minto	Yes	150	4.7%	1.3%	94.0%	0.7%	0.0%	0.0%	0.0%	95.3%	Yes	18.3%	–	20.5%	Yes
Nenana	Yes	358	57.8%	0.8%	41.9%	0.0%	0.0%	0.0%	0.0%	42.2%	Yes	9.7%	43,750	27.6%	Yes
Nulato	Yes	239	7.1%	2.1%	90.0%	2.5%	0.4%	0.0%	1.7%	92.9%	Yes	14.2%	50,375	16.2%	Yes
Rampart	Yes	57	10.5%	7.0%	89.5%	0.0%	0.0%	0.0%	0.0%	89.5%	Yes	8.0%	–	23.9%	Yes
Ruby	Yes	139	5.8%	0.0%	92.8%	1.4%	0.0%	0.0%	0.7%	94.2%	Yes	0.0%	40,000	15.0%	Yes
Stevens Village	Yes	37	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	Yes	60.0%	–	22.2%	Yes
Tanana	Yes	246	16.7%	0.4%	82.1%	0.8%	0.0%	0.8%	1.6%	83.3%	Yes	12.4%	47,500	20.0%	Yes
Wiseman	No	5	80.0%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	20.0%	No	0.0%	–	0.0%	No

Source: U.S. Census Bureau 2023

Note: EJ = environmental justice; N/A = not applicable; NA = not available.

[a] Alone, non-Hispanic, or Latino.

[b] Alone or in combination with one or more other races.

[c] Hispanic or Latino, can be of any race.

[d] 100 percent minus "White, non-Hispanic, or Latino."

Table 22. Summary of potential impacts on environmental justice population*

Resource	Effects in relation to EJ communities	DH&A effects?
Geology and Soils (3.2.1)	Impacts generally occur to natural systems and not directly to people, but any NOA that resulted in asbestos in road could have disproportionately high and adverse public health effects to EJ communities. See Socioeconomics and Communities below.	Likely
Sand and Gravel Resources (3.2.2)	No effects in relation to EJ communities.	No
Hazardous Waste (3.2.3)	Toxic spills are likely to occur at a small scale under any action alternative. Large spills or releases from a truck rollover could occur and damage adjacent waterways and habitat. Large releases are not likely, but if such a release did occur, it could result in disproportionately high and adverse public health effects to EJ communities. See Socioeconomics and Communities below.	Likely
Paleontological Resources (3.2.4)	No effects in relation to EJ communities.	No
Water Resources (3.2.5)	Impacts generally occur to natural systems and not directly to people, but any spills or chronic production of toxic materials or dust in water that have an adverse impact to animal and plant resources which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below.	Likely
Acoustical Environment (Noise) (3.2.6)	Impacts generally occur to natural systems and not directly to people, but any adverse impact to the abundance and availability of animals which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below.	Likely
Air Quality and Climate (3.2.7)	Impacts generally occur to natural systems and not directly to people, but any asbestos or other toxins in road dust could have disproportionately high and adverse public health effects to EJ communities. See Socioeconomics and Communities below.	Likely
Vegetation and Wetlands (3.3.1)	Impacts generally occur to natural systems and not directly to people, but any adverse impact to the abundance and availability of plants which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below..	Likely
Fish and Aquatics (3.3.2)	Impacts generally occur to natural systems and not directly to people, but any adverse impact to the abundance and availability of fish which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below.	Likely
Birds (3.3.3)	Impacts generally occur to natural systems and not directly to people, but any impact to the abundance and availability of birds which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below	Likely

Resource	Effects in relation to EJ communities	DH&A effects?
Mammals (3.3.4)	Impacts generally occur to natural systems and not directly to people, but any impact to the abundance and availability of mammals which EJ communities use for subsistence purposes could result in disproportionately high and adverse effects to EJ communities. See Subsistence Uses and Resources below	Likely
Land Ownership, Use, Management and Special Designations (3.4.1)	No changes to underlying land ownership.	No
Transportation and Access (3.4.2)	The road would impede free overland travel (e.g., by snowmobile) , disproportionately affecting EJ communities, but access points for crossing the road would be provided in the most used areas.	Likely
Recreation and Tourism (3.4.3)	Adverse impacts to the existing recreation and tourism experience would affect both local people and outside visitors. These adverse impacts would not fall disproportionately on EJ communities.	No
Visual Resources (3.4.4)	Adverse impacts to the visual environment due to creation of a linear engineered element in a primarily natural environment would affect both local people and outside visitors. These adverse impacts would not fall disproportionately on EJ communities.	No
Socioeconomics and Communities (3.4.5)	Potential for increased employment and income opportunities. Beneficial effects to local, regional, and State of Alaska economy. Potential to reduce cost of living. The beneficial impacts of employment would not disproportionately fall to EJ communities. Beneficial impacts of lower cost fuel and goods would accrue to Kobuk residents and likely to 2-3 other communities, and these benefits would disproportionately fall to EJ communities in these villages. There is potential for high and adverse impacts due to changes in subsistence (see below), easier importation of drugs and alcohol, and mixing with a typically young, single male road and mine worker crews, but limits on crew travel to local communities from their work sites is expected to limit the impact. If high and adverse impacts did occur, they would fall disproportionately to EJ communities in the villages closest to the alternatives. Increased access to drugs and alcohol and potential for sex trafficking and gender violence has been a tribal concern shared during Government-to-Government consultation with the BLM. Other potential adverse public health effects that may disproportionately affect minority and low-income populations due to their proximity to the proposed road include increased exposure to NOA materials and exposure to hazardous waste spills and toxic road dust.	Likely
Subsistence Uses and Resources (3.4.7)	There will be impacts to subsistence use areas, access to resources, and availability of resources. See Table 20 below for details. The road itself would impede access to subsistence resources (see Transportation above) and could reduce the abundance and availability of subsistence resources (see Vegetation and Wetlands, Birds, Fish, and Mammals above). Spills or chronic production of toxic materials or dust in water could affect important salmon and sheefish habitat (see Water Resources above). These effects on subsistence resources from the road, combined with the effects from mining and other stressors on subsistence resources, would result in disproportionately high and adverse effects to EJ communities, particularly those nearest to the road.	Likely
Cultural Resources (3.4.8)	There is potential for impacts to known cultural resources and to potentially historic trails. There is high likelihood that there are ethnographic resources and cultural properties in the proposed road corridors that have not yet been identified and that impacts would occur to them. Impacts would affect the legacy of these sites for all Americans but likely would be felt most strongly among local tribes composed largely of EJ populations.	Likely

Note: DH&A = disproportionately high and adverse; EJ = environmental justice; NOA = naturally occurring asbestos.

1.7. Subsistence Uses and Resources*

1.7.1 Affected Environment

Table 23 lists the subsistence communities for the analysis.

Table 24 provides average harvest and participation data for all resources for the subsistence study communities. Note that Livengood is not included in this table as there is no harvest data.

Table 25 provides average moose harvest and participation data for the 27 subsistence study communities.

Table 26 provides caribou use and harvest averages, across all available study years, for the caribou study communities listed in Table 23 as members of the WAH WG, as well as depicted on Volume 4, Map 3-32. Note that Fairbanks and Koyukuk are not included in Table 26 because they have no available caribou harvest data.

1.7.2 Environmental Consequences

Table 28 provides the number of subsistence study communities with subsistence use areas that are crossed by an alternative by resource type. Table 29 includes communities most likely to have subsistence impacts under each alternative.

Table 23. Ambler Road EIS subsistence, Western Arctic Caribou Herd Working Group, and Fish study communities*

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
1	Beaver	SUB	No	No	Yes	No
2	Coldfoot	SUB	Yes	Yes	Yes	No
3	Livengood	SUB	Yes	No	No	No
4	Manley Hot Springs	SUB	Yes	No	Yes	No
5	Minto	SUB	Yes	No	Yes	No
6	Nenana	SUB	No	No	Yes	No
7	Stevens Village	SUB	Yes	Yes	Yes	No
8	Alatna	SUB/FISH	Yes	Yes	Yes	Yes
9	Evansville	SUB/FISH	Yes	Yes	Yes	No
10	Rampart	SUB/FISH	Yes	Yes	Yes	No
11	Tanana	SUB/FISH	Yes	Yes	Yes	No
12	Anaktuvuk Pass	SUB/WAH	No	Yes	Yes	Yes
13	Buckland	SUB/WAH	No	No	Yes	Yes
14	Noatak	SUB/WAH	No	No	Yes	Yes
15	Selawik	SUB/WAH	No	Yes	Yes	Yes
16	Wiseman	SUB/WAH	Yes	Yes	Yes	Yes
17	Allakaket	SUB/WAH/FISH	Yes	Yes	Yes	Yes
18	Ambler	SUB/WAH/FISH	Yes	Yes	Yes	Yes
19	Bettles	SUB/WAH/FISH	Yes	Yes	Yes	Yes
20	Galena	SUB/WAH/FISH	No	Yes	Yes	Yes
21	Hughes	SUB/WAH/FISH	Yes	Yes	Yes	Yes
22	Huslia	SUB/WAH/FISH	Yes	No	No	Yes
23	Kiana	SUB/WAH/FISH	No	Yes	Yes	Yes
24	Kobuk	SUB/WAH/FISH	Yes	Yes	Yes	Yes
25	Kotzebue	SUB/WAH/FISH	No	No	Yes	Yes
26	Noorvik	SUB/WAH/FISH	No	No	Yes	Yes

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
27	Shungnak	SUB/WAH/FISH	Yes	Yes	Yes	Yes
28	Alakanuk	FISH	No	No	No	No
29	Anvik	FISH	No	No	No	No
30	Emmonak	FISH	No	No	No	No
31	Grayling	FISH	No	No	No	No
32	Holy Cross	FISH	No	No	No	No
33	Marshall	FISH	No	No	No	No
34	Mountain Village	FISH	No	No	No	No
35	Nunam Iqua	FISH	No	No	No	No
36	Pilot Station	FISH	No	No	No	No
37	Pitka's Point	FISH	No	No	No	No
38	Ruby	FISH	No	No	No	No
39	Russian Mission	FISH	No	No	No	No
40	St. Mary's	FISH	No	No	No	No
41	Atqasuk	WAH	No	No	No	Yes
42	Brevig Mission	WAH	No	No	No	Yes
43	Deering	WAH	Yes	No	No	Yes
44	Elim	WAH	Yes	No	No	Yes
45	Fairbanks	WAH	No	No	No	Yes
46	Golovin	WAH	Yes	No	No	Yes
47	Kivalina	WAH	Yes	No	No	Yes
48	Koyuk	WAH	Yes	No	No	Yes
49	Nome	WAH	No	No	No	Yes
50	Nuiqsut	WAH	No	No	No	Yes
51	Point Hope	WAH	No	No	No	Yes
52	Point Lay	WAH	No	No	No	Yes
53	Shaktoolik	WAH	No	No	No	Yes

Study community number	Study community	Study community type	Community within 50 miles	Community use areas overlap the project	Community use areas within 30 miles	Member of WAH WG
54	Shishmaref	WAH	No	No	No	Yes
55	St. Michael	WAH	No	No	No	Yes
56	Stebbins	WAH	No	No	No	Yes
57	Teller	WAH	No	No	No	Yes
58	Unalakleet	WAH	No	No	No	Yes
59	Utqiagvik	WAH	No	No	No	Yes
60	Wainwright	WAH	No	No	No	Yes
61	Wales	WAH	No	No	No	Yes
62	White Mountain	WAH	Yes	No	No	Yes
63	Kaltag	WAH/FISH	No	No	No	Yes
64	Kotlik	WAH/FISH	No	No	No	Yes
65	Koyukuk	WAH/FISH	No	No	No	Yes
66	Nulato	WAH/FISH	No	No	No	Yes

FISH = fish study community; SUB = subsistence study community; WAH = Western Arctic Caribou Herd Working Group study community.

Table 24. All resources harvest and participation data, average across available study years, subsistence study communities*

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Alatna	100	100	100	100	100	97,760	2,274	633	Salmon (48.5) LLM (28.8) NSF (16.4)
Allakaket	100	95	90	86	100	114,651	2,349	689	Salmon (53.4) NSF (22.9) LLM (18.7)
Ambler	98	96	96	87	92	170,468	2,243	603	LLM (59.9) NSF (28.9) Salmon (5.9)
Anaktuvuk Pass	98	77	75	76	95	69,825	1,122	316	LLM (89.6) NSF (7.9) Vegetation (1.9)

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Beaver	100	98	96	78	95	43,301	1,277	545	Salmon (49.8) LLM (30.7) NSF (7.3)
Bettles	100	88	88	88	100	11,010	446	186	LLM (67.2) Salmon (15.2) NSF (10.1)
Buckland	99	92	92	87	90	275,556	2,894	554	LLM (43.2) Marine Mammals (18.8) NSF (16.1)
Coldfoot	100	100	100	50	100	381	76	38	LLM (85.3) Vegetation (14.7)
Evansville	100	100	100	77	100	10,748	401	155	LLM (57.9 Salmon (18.1) NSF (11.6
Galena	96	85	87	65	86	325,368	1,628	520	Salmon (58.0) LLM (27.6) NSF (10.1)
Hughes	96	85	77	62	96	87,069	3,697	926	Salmon (60.8) LLM (24.6) NSF (10.7)
Huslia	N/A	N/A	100	N/A	N/A	208,165	3,652	1082	Salmon (51.2) LLM (35.0) NSF (8.4)
Kiana	99	92	92	N/A	N/A	133,211	1,402	347	LLM (37.7) NSF (28.7) Salmon (24.4)
Kobuk	100	100	100	90	100	50,743	1,410	309	LLM (36.1) Salmon (29.8) NSF (27.2)
Kotzebue	99	88	87	79	96	1,278,772	1,601	398	LLM (31.5) Marine Mammals (23.0) NSF (22.9)
Manley Hot Springs	100	98	98	71	93	52,438	904	426	Salmon (82.0) NSF (7.4) LLM (5.0)

Study community	% of HH using	% of HH trying to harvest	% of HH harvesting	% of HH giving	% of HH receiving	Estimated pounds harvested	Average HH pounds	Per capita pounds	Top 3 resource categories (by % of total harvest)
Minto	98	97	95	74	93	115,196	2,312	620	Salmon (55.3) LLM (23.6) NSF (13.1)
Nenana	98	86	78	54	87	64,965	267	111	Salmon (41.0) LLM (33.3) NSF (12.0)
Noatak	96	95	95	91	92	96,797	88,230	412	LLM (41.9) Salmon (20.0) NSF (19.5)
Noorvik	100	94	93	75	96	353,142	2,616	603	NSF (38.5) LLM (36.8) Salmon (17.1)
Rampart	100	86	86	86	100	14,754	1,135	378	Salmon (60.9) LLM (27.2) NSF (8.3)
Selawik	99	91	91	89	97	456,493	2,701	533	NSF (67.9) LLM (25.1) Migratory Birds (2.7)
Shungnak	100	100	100	83	98	126,376	2,137	489	LLM (48.0) NSF (32.0) Salmon (15.2)
Stevens Village	100	75	88	50	100	53,117	2,177	757	Salmon (81.5) NSF (10.6) LLM (3.2)
Tanana	100	93	92	84	98	745,940	5,828	2157	Salmon (74.2) NSF (16.6) LLM (6.5)
Wiseman	100	100	100	100	100	4,143	764	294	LLM (78.2) Upland Game Birds (5.0) Vegetation (4.9)
All Communities	99	92	92	78	96	190,784	5,213	542	N/A

Source: See Appendix L, Table 41

Note: HH = households; LLM = large land mammal; N/A = not applicable; NSF = non-salmon fish.

The 26 communities listed in this table, in addition to Livengood, make up the 27 primary subsistence study communities. Comprehensive harvest data are not available for Livengood and therefore are not included in this table.

[a] Estimated number harvested not available for all resources data.

Table 25. Moose harvest data, average across all available study years*

Community	% HHs use	% HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Alatna	98	75	50	41	74	15	7,905	355	117	16.0
Allakaket	97	73	52	45	65	34	17,676	332	98	12.9
Ambler	36	21	13	14	26	10	5,231	74	20	4.5
Anaktuvuk Pass	29	10	6	9	24	4	2,230	25	7	3.2
Beaver	33	27	12	12	28	10	5,927	277	90	25.1
Bettles	88	35	24	40	62	8	3,792	193	72	51.5
Buckland	27	18	9	13	17	13	7,003	74	15	3.2
Coldfoot	25	NA	NA	NA	25	NA	NA	NA	NA	NA
Evansville	78	33	20	39	68	7	3,201	133	55	51.4
Galena	90	64	48	34	55	106	60,907	316	108	25.6
Hughes	96	62	57	35	69	26	13,083	538	140	17.6
Huslia	99	66	58	36	52	79	44,744	608	198	28.8
Kiana	29	16	13	9	14	13	7,054	72	19	6.5
Kobuk	48	45	16	16	43	6	2,958	95	21	3.8
Kotzebue	47	23	12	16	38	105	56,591	70	18	5.4
Manley Hot Springs	59	50	11	25	49	8	4,498	123	55	4.9
Minto	90	70	39	34	74	32	18,732	309	96	22.5
Nenana	49	69	22	8	29	62	40,213	223	83	NA
Noatak	39	28	24	21	32	377	3,973	386	8	2.3
Noorvik	57	28	20	18	43	35	18,902	129	28	3.7
Rampart	86	57	57	43	86	4	4,011	309	103	27.2
Selawik	65	36	25	36	53	50	26,775	164	35	4.7
Shungnak	57	27	19	16	41	12	6,302	113	25	3.1
Stevens Village	60	56	25	14	44	31	1,630	82	24	1.5
Tanana	94	67	38	42	70	48	27,253	258	105	5.4

Community	% HHs use	% HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Wiseman	100	80	60	60	40	4	1,890	432	166	46.4
All communities	64	45	30	27	47	44	15,691	228	68	15.8

Note: There are no harvest data for the subsistence study community of Livengood. HHs = households; lbs = pounds; NA = not available.

Table 26. Caribou harvest data, average across all available study years, Western Arctic Herd study communities*

Community	% of HHs using	% of HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Allakaket	72	38	15	21	52	32	4,129	80	22	4.2
Ambler	88	74	69	56	51	489	66,473	937	255	54.6
Anaktuvuk Pass	92	61	49	49	68	514	65,678	784	222	86.2
Atqasuk	96	70	65	71	65	257	N/A	N/A	N/A	N/A
Bettles	62	29	18	32	32	11	1,387	106	38	14.1
Brevig Mission	44	20	13	16	37	37	6,189	88	22	4.7
Buckland	87	70	66	56	59	704	95,692	1,006	195	39.0
Deering	90	55	48	53	69	268	36,376	773	244	42.1
Elim	92	63	51	56	77	153	20,844	276	70	N/A
Galena	13	5	4	4	10	18	2,801	15	5	1.1
Golovin	79	30	21	22	67	57	7,707	161	32	10.3
Hughes	31	27	6	4	18	10	1,360	40	15	4.2
Huslia	75	40	33	23	38	107	13,880	182	60	3.3
Kaltag	12	5	4	4	9	5	663	11	3	0.0
Kiana	89	70	66	53	65	403	54,755	559	144	31.2
Kivalina	90	69	56	57	70	412	57,326	1,550	251	25.7
Kobuk	89	78	66	57	63	154	20,976	655	147	31.8
Kotlik	N/A	N/A	7	N/A	N/A	8	1,600	29	4	NA

Community	% of HHs using	% of HHs trying to harvest	% of HHs harvesting	% of HHs giving	% of HHs receiving	Estimated harvest total number	Estimated harvest total lbs	Estimated harvest average HH lbs	Estimated harvest per capita lbs	% of total harvest
Kotzebue	86	49	42	47	64	2,094	284,711	353	90	25.7
Koyuk	93	63	54	49	65	267	36,355	432	108	40.0
Noatak	88	66	60	54	67	416	44,761	12,355	124	39.6
Noorvik	95	67	67	48	60	869	118,140	818	184	32.8
Nuiqsut	96	72	67	71	75	507	63,281	746	165	29.9
Nulato	5	3	3	2	3	4	552	7	2	0.0
Point Hope	91	55	30	51	80	394	48,118	201	51	15.4
Point Lay	94	66	66	67	75	223	29,501	494	149	25.5
Selawik	97	65	59	67	82	969	131,801	810	174	20.4
Shaktoolik	84	54	51	43	67	156	21,196	361	93	N/A
Shishmaref	79	42	37	48	62	340	46,211	340	83	13.7
Shungnak	97	66	64	48	60	441	60,044	1,055	237	44.7
St. Michael	68	29	18	16	57	33	4,413	47	10	NA
Stebbins	7	5	1	2	5	9	1,161	9	2	0.9
Teller	34	4	3	3	32	11	2,823	20	6	NA
Unalakleet	83	42	37	32	64	481	65,468	317	93	NA
Utqiaġvik	70	43	31	38	52	2,330	296,175	245	69	24.8
Wainwright	97	67	61	62	84	864	104,696	714	200	28.3
Wales	22	2	1	5	22	1	122	2	1	0.4
White Mountain	80	35	26	28	65	77	10,449	160	52	8.8
Wiseman	80	80	60	60	20	7	890	104	40	20.9
All communities	72	46	38	39	53	360	48,087	705	98	25.1

Source: See Appendix L, Table 2, and ADF&G 2023
Note: HHs = households; lbs = pounds; N/A = not applicable; NA = not available.

Table 27. Fish subsistence harvest data, average across all available study years, fish study communities*

Study community	Species	% HHs use	% HHs try to harvest	% HHs harvest	% HHs give	% HHs receive	Total # harvest	Estimated lbs harvested	Average HH lbs	Per capita lbs	% of total harvest
Alakanuk	Chinook Salmon	N/A	N/A	86	N/A	N/A	2,717	43,203	480	73	10.0%
	Chum Salmon	N/A	N/A	100	N/A	N/A	13,693	66,821	742	112	15.5%
	Sheefish	81	59	60	41	34	3,312	21,524	200	35	7.4%
Alatna	Chinook Salmon	33	33	50	33	28	367	6,644	139	39	3.9%
	Chum Salmon	50	33	42	33	33	8,865	54,036	1,157	321	44.3%
	Sheefish	67	67	47	29	33	1,335	9,340	203	56	9.6%
Allakaket	Chinook Salmon	48	29	39	24	33	317	5,374	111	32	4.4%
	Chum Salmon	50	38	42	31	19	9,723	58,398	1,216	346	48.2%
	Sheefish	72	53	55	34	27	1,968	13,111	266	80	12.5%
Ambler	Chinook Salmon	7	4	4	0	4	3	46	1	0	0.0%
	Chum Salmon	76	53	52	34	57	2,902	20,262	281	80	5.4%
	Sheefish	87	72	69	47	56	1,481	20,966	291	84	7.5%
Anvik	Chinook Salmon	100	88	88	39	48	1,246	15,805	497	181	31.7%
	Chum Salmon	58	42	42	13	21	1,072	5,434	172	60	10.8%
	Sheefish	60	51	54	19	31	285	1,982	61	22	3.1%
Bettles	Chinook Salmon	25	N/A	2	13	13	9	159	5	2	1.0%
	Chum Salmon	13	13	13	N/A	0	338	2,057	79	29	14.3%
	Sheefish	29	8	8	17	17	80	558	22	8	3.4%
Emmonak	Chinook Salmon	89	55	62	35	65	2,649	33,404	266	59	10.6%
	Chum Salmon	91	70	70	41	58	15,638	78,897	572	128	23.7%
	Sheefish	70	51	55	28	40	3,390	27,115	222	50	8.7%
Evansville	Chinook Salmon	46	8	6	15	28	8	133	5	2	2.3%
	Chum Salmon	N/A	N/A	21	N/A	5	447	2,725	103	38	13.7%
	Sheefish	38	8	12	12	24	65	454	18	7	4.2%

Study community	Species	% HHs use	% HHs try to harvest	% HHs harvest	% HHs give	% HHs receive	Total # harvest	Estimated lbs harvested	Average HH lbs	Per capita lbs	% of total harvest
Galena	Chinook Salmon	71	41	31	20	46	2,373	29,060	150	49	11.3%
	Chum Salmon	59	26	26	15	35	37,770	180,319	876	274	43.4%
	Sheefish	36	26	25	13	13	1,008	6,308	33	12	1.8%
Grayling	Chinook Salmon	97	84	81	46	48	1,894	24,940	539	143	20.3%
	Chum Salmon	59	39	37	29	27	5,416	27,094	574	139	17.4%
	Sheefish	76	67	72	34	44	786	5,515	116	29	3.9%
Holy Cross	Chinook Salmon	N/A	N/A	N/A	N/A	N/A	1,649	22,756	274	83	13.1%
	Chum Salmon	N/A	N/A	N/A	N/A	N/A	1,218	5,793	70	21	3.3%
	Sheefish	4	2	21	2	2	376	2,816	34	10	3.2%
Hughes	Chinook Salmon	N/A	N/A	68	N/A	16	586	10,603	482	112	7.5%
	Chum Salmon	46	19	19	15	39	15,195	56,895	2,474	603	56.8%
	Sheefish	54	37	48	9	18	232	1,514	62	18	2.3%
Huslia	Chinook Salmon	N/A	N/A	34	13	39	297	4,072	71	21	2.0%
	Chum Salmon	N/A	N/A	43	14	41	22,583	102,603	1,800	533	49.3%
	Sheefish	60	31	34	20	37	896	5,815	85	27	3.0%
Kaltag	Chinook Salmon	85	58	44	42	33	1,323	13,097	214	74	33.8%
	Chum Salmon	67	44	42	27	29	20,905	85,002	1,352	335	13.2%
	Sheefish	61	44	42	23	30	280	1,592	25	9	4.1%
Kiana	Chinook Salmon	12	4	4	2	8	14	160	2	0	0.4%
	Chum Salmon	86	62	58	37	79	3,298	19,199	199	48	20.7%
	Sheefish	76	59	57	32	58	1,485	15,018	154	37	5.4%
Kobuk	Chinook Salmon	4	4	4	0	0	2	24	1	0	0.0%
	Chum Salmon	83	63	60	38	54	2,174	12,841	384	84	29.5%
	Sheefish	94	81	79	42	43	903	10,199	306	67	23.3%
Kotlik	Chinook Salmon	N/A	N/A	50	N/A	N/A	1,060	16,854	301	45	8.9%
	Chum Salmon	N/A	N/A	86	N/A	N/A	6,884	33,594	600	89	17.8%
	Sheefish	89	62	67	37	58	2,867	18,457	237	42	13.6%

Study community	Species	% HHs use	% HHs try to harvest	% HHs harvest	% HHs give	% HHs receive	Total # harvest	Estimated lbs harvested	Average HH lbs	Per capita lbs	% of total harvest
Kotzebue	Chinook Salmon	13	6	5	3	9	266	3,050	4	1	0.2%
	Chum Salmon	84	47	45	41	60	32,714	199,009	244	59	17.0%
	Sheefish	82	54	52	42	52	39,545	217,497	271	66	15.9%
Koyukuk	Chinook Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Chum Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sheefish	66	48	48	16	41	384	2,304	52	22	N/A
Marshall	Chinook Salmon	89	72	67	50	39	3,304	31,186	367	91	23.2%
	Chum Salmon	89	72	70	41	37	5,981	30,408	358	89	22.6%
	Sheefish	19	13	12	8	10	838	4,750	47	12	3.8%
Mountain Village	Chinook Salmon	85	53	70	38	57	2,260	28,838	249	49	9.4%
	Chum Salmon	83	52	73	38	56	14,415	71,511	600	119	24.0%
	Sheefish	60	40	46	34	45	2,906	16,147	133	28	6.4%
Noorvik	Chinook Salmon	8	5	4	2	4	25	236	2	0	0.0%
	Chum Salmon	89	47	45	42	66	15,408	93,115	719	165	16.3%
	Sheefish	82	56	54	36	54	4,054	45,697	348	80	19.0%
Nulato	Chinook Salmon	87	61	60	36	45	2,000	18,878	208	73	30.4%
	Chum Salmon	37	30	27	13	14	991	5,039	56	19	8.1%
	Sheefish	59	37	36	20	32	466	2,797	32	10	3.6%
Nunam Iqua	Chinook Salmon	N/A	N/A	100	N/A	N/A	1,912	30,405	1,322	220	15.8%
	Chum Salmon	N/A	N/A	100	N/A	N/A	11,487	56,056	2,437	406	29.2%
	Sheefish	83	63	68	27	63	1,928	13,506	504	91	9.7%
Pilot Station	Chinook Salmon	55	20	19	6	43	211	2,022	16	3	2.0%
	Chum Salmon	92	35	35	26	78	24,273	24,273	190	39	24.5%
	Sheefish	53	32	31	18	31	623	3,523	27	6	3.4%
Pitka's Point	Chinook Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Chum Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sheefish	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Study community	Species	% HHs use	% HHs try to harvest	% HHs harvest	% HHs give	% HHs receive	Total # harvest	Estimated lbs harvested	Average HH lbs	Per capita lbs	% of total harvest
Rampart	Chinook Salmon	0	0	0	0	0	0	0	0	0	0.0%
	Chum Salmon	57	57	57	29	29	500	4,673	359	120	31.7%
	Sheefish	29	29	29	0	0	13	145	11	4	1.0%
Ruby	Chinook Salmon	77	45	40	32	47	1,531	14,448	219	80	26.7%
	Chum Salmon	55	40	38	17	23	2,735	13,907	211	77	25.7%
	Sheefish	41	27	25	13	23	158	950	15	5	1.3%
Russian Mission	Chinook Salmon	85	74	63	28	37	2,557	30,666	511	104	22.3%
	Chum Salmon	N/A	N/A	37	N/A	N/A	2,731	14,596	252	51	9.0%
	Sheefish	41	33	33	13	11	541	3,515	44	9	2.7%
Saint Mary's	Chinook Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Chum Salmon	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Sheefish	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shungnak	Chinook Salmon	4	1	0	1	4	0	0	0	0	0.0%
	Chum Salmon	78	52	50	30	58	4,691	28,070	452	105	14.8%
	Sheefish	85	64	64	35	56	2,565	26,155	414	98	12.2%
Tanana	Chinook Salmon	92	53	52	46	47	4,769	81,079	633	270	10.9%
	Chum Salmon	70	66	62	28	27	67,411	400,317	3,127	1,158	53.7%
	Sheefish	36	32	32	15	11	3,042	19,566	155	56	4.6%
All Communities	Chinook Salmon	53	36	40	22	30	1,219	16,108	244	62	10.4%
Average	Chum Salmon	67	45	50	29	39	12,119	60,446	747	195	24.3%
	Sheefish	60	43	44	24	33	2,594	17,295	146	36	6.9%

Source: ADF&G 2023
Note: HHs = households; lbs = pounds; N/A = not applicable; NA = not available.

Table 28. Number of communities with use areas crossing the project, by alternative and resource

Resource	Number of communities crossing Alternative A	Number of communities crossing Alternative B	Number of communities crossing Alternative C	Number of communities crossing any alternative	Alternative(s) affecting greatest number of communities
Moose	9	9	8	12	A, B
Caribou	9	9	10	12	C
Dall sheep	6	6	3	6	A, B
Bear	5	5	7	7	C
Other large land mammals	0	0	0	0	N/A
Small land mammals	8	9	11	15	C
Marine mammals	0	0	0	0	N/A
Migratory birds	6	5	6	9	A, C
Upland game birds	4	4	3	7	A, B
Eggs	2	2	0	2	A, B
Salmon	3	3	5	6	C
Non-salmon fish	3	3	8	10	C
Marine invertebrates	0	0	0	0	N/A
Vegetation	6	7	6	10	B
Total number of communities crossed	12	12	12	16	N/A

Source: Appendix L, Maps 2 through 27
Note: N/A = not applicable.

Table 29. Communities most likely to experience direct subsistence impacts*

Community	No Action Alternative	Alternative A	Alternative B	Alternative C
Alatna	N/A	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area
Allakaket	N/A	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area

Community	No Action Alternative	Alternative A	Alternative B	Alternative C
Ambler	N/A	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area
Anaktuvuk Pass	N/A	On periphery of subsistence use areas	On periphery of subsistence use areas	On periphery of subsistence use areas
Bettles	N/A	Bisects subsistence use areas	Bisects subsistence use areas	N/A
Coldfoot	N/A	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area	N/A
Evansville	N/A	Bisects subsistence use areas	Bisects subsistence use areas	N/A
Hughes	N/A	On periphery of subsistence use areas	On periphery of subsistence use areas	Bisects subsistence use areas
Huslia	N/A	Could cause downstream impact to fish	Could cause downstream impact to fish	Intersects a portion of subsistence use area; could cause downstream impact to fish
Kobuk	N/A	Bisects subsistence use areas	Bisects subsistence use areas	Bisects subsistence use areas
Selawik	N/A	On periphery of subsistence use areas	On periphery of subsistence use areas	On periphery of subsistence use areas
Shungnak	N/A	Bisects subsistence use areas	Bisects subsistence use areas	Bisects subsistence use areas
Stevens Village	N/A	N/A	N/A	On periphery of subsistence use areas
Tanana	N/A	N/A	N/A	On periphery of subsistence use areas
Wiseman	N/A	Intersects a portion of subsistence use area	Intersects a portion of subsistence use area	N/A

Note: N/A = not applicable. Bisecting subsistence use areas is considered to indicate likely greatest impact. An alternative “intersecting a portion,” on the “periphery,” and possibly causing “downstream impact” generally indicate successively lower impact.

Table 30. Resource importance of caribou, caribou study communities*

Study community	Resource importance
Allakaket	H
Ambler	H
Anaktuvuk Pass	H
Atqasuk	H
Buckland	H
Deering	H
Elim	H
Golovin	H
Kiana	H
Kivalina	H
Kobuk	H
Kotzebue	H
Koyuk	H
Noatak	H
Noorvik	H
Nuiqsut	H
Point Hope	H
Point Lay	H
Selawik	H
Shishmaref	H
Shungnak	H
St. Michael	H
Unalakleet	H
Utqiagvik	H
Wainwright	H
White Mountain	H
Wiseman	H
Bettles	M
Brevig Mission	M
Hughes	M
Huslia	M
Teller	M
Galena	L
Kaltag	L
Kotlik	L
Nulato	L
Stebbins	L
Wales	L

Study community	Resource importance
Fairbanks	No Data
Koyukuk	No Data
Nome	No Data
Shaktoolik	No Data

H = Resource of High Importance; M = Resource of Moderate Importance; L = Resource of Low Importance

Table 31. Resource importance of chum salmon, Chinook salmon, and sheefish, fish study communities*

Study Community	Chinook salmon	Chum salmon	Sheefish	All
Alatna	M	H	M	H
Allakaket	M	H	M	H
Ambler	L	H	H	H
Anvik	H	M	M	H
Emmonak	H	H	M	H
Galena	M	H	M	H
Grayling	H	M	H	H
Hughes	M	H	M	H
Huslia	M	H	M	H
Kaltag	H	M	M	H
Kiana	L	H	H	H
Kobuk	L	H	H	H
Kotzebue	L	H	M	H
Marshall	H	H	M	H
Mountain Village	M	H	M	H
Noorvik	L	H	H	H
Nulato	H	M	M	H
Nunam Iqua	M	H	H	H
Pilot Station	M	H	M	H
Rampart	L	H	L	H
Ruby	H	H	L	H
Russian Mission	H	M	M	H
Shungnak	H	H	L	H
Tanana	M	H	M	H
Alakanuk	M	M	M	M
Bettles	L	M	M	M
Evansville	M	M	M	M
Holy Cross	M	M	M	M
Kotlik	M	M	M	M
Koyukuk	No Data			

Study Community	Chinook salmon	Chum salmon	Sheefish	All
Pitka's Point		No Data		
St. Mary's		No Data		

Note: H = resource of high importance; L = resource of low importance; M = resource of moderate importance.

1.8. Cultural Resources*

1.8.1 Affected Environment

Table 32 provides the generalized archaeology chronology of the study area, including details on the type of cultural complex and representative sites and their characteristics.

Table 32. Generalized archaeology chronology of the study area

Cultural complex	Chronology	Characteristics and representative sites
Paleo-Indian Period	11,700–8,000 BP	Lanceolate projectile points, distinctive gravers, end scrapers, blades, and debitage Mesa and Sluiceway complexes; Utukok River sites, Putu, Mesa
American Paleoarctic Tradition	10,000–7,000 BP	Core and blade technology characterized by wedge-shaped microblade cores, microblades, blades, burins, and ellipsoidal bifaces Onion Portage, Gallagher Flint Station, Lisburn Site
Northern Archaic Tradition	6,500–3,500 BP	Side-notched projectile points, some presence of microblades Kurupa Lake, Tuktu Lake, Onion Portage
Denbigh Flint Complex	4,250–2,600 BP	Well-made, tiny bifacial tools and projectile points; microblades, burins, and insets Iyatayet Site, Cape Denbigh, Onion Portage
Choris	2,800–2,200 BP	Large, finely made projectile points, ground slate tools, pottery, burin spalls, and adze blades. Large oval-shaped structures; elliptical houses and associated material culture that includes lanceolate projectile points, adze blades (for insertion into antler shafts), and flaked burins Cape Krusenstern, Choris Peninsula, Onion Portage
Norton	2,500–1,800 years ago	Greater dependence on marine resources, including fish; abundance of net sinkers; coarser material types compared to earlier periods; check-stamped pottery, deep square houses Iyatayet site
Ipiutak	1,950–1,100 BP	Elaborate burial goods carved of ivory, use of iron, Denbigh-like inset styles, uniface knives, Norton style discoid scrapers, bifaces and burins, lack of pottery, and ground slate artifacts Point Hope, Anaktuvuk Pass
Northern Maritime Tradition	1,600 BP–European Contact	Increased exploitation of marine mammals, stamped pottery, ground slate tools, flaked stone insets, ivory artifacts Cape Krusenstern, Birnirk
Arctic Woodland	800–200 BP	Caribou-oriented, interior, Eskimo culture, square house pits with entrance tunnels Kobuk River sites, Kotzebue coastal area
Athabascan Tradition	200–120 BP	Variations in semi-subterranean house structures or winter houses (*ookevik*) and variations in lithic technology; subsurface house pits and cache pits; European trade goods at later sites Lake 324 complex at Batza Tena, Onion Portage

Source: Blanchard 2014; BLM 2012; Giddings and Anderson 1988
Note: BP = before present.

Table 33 lists the types of previous survey efforts that have occurred within Meridian, Township, Range, and Sections (MTRS) that intersecting with the project alternatives.

Table 33. Previous surveys within and near the project route corridors*

Alternative	Survey	Annual reports	Determination of eligibility	Letter	Other	Total
Alt A - AIDEA Proposed	18	4	2	1	1	26
Alt B - AIDEA Alternative	18	4	2	1	1	26
Alt C – Diagonal Route	17	3	2	1	1	24

Source: ADNR, Office of History and Archaeology 2023

Note: Results based on analysis of project route corridors intersecting associated Meridian, Township, Range, and Section (MTRS). "Other" refers to various non-survey related documents including historic contexts, site records, building documentation, and NRHP nomination forms. Reports for Alternatives A and B are identical. Ten reports from Alt A/B also apply to Alternative C.

Table 34. Indigenous place names in study area*

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
1	Akoliakruich Hills	Avgun	divide/are split	Range	Iñupiaq	Point
2	Alatna River	KY: Aalaatne, IN: Aalaasuq	KY: Ω river (likely Inupiaq-origin name). IN: ?	Stream	Koyukon, Iñupiaq	Line
3	Ambler Lowland	Iñġitch tunuat	behind the mountains	Region	Iñupiaq	Point
4	Ambler River	Natmaktuġiam kuuŋa	relay pack across the divide river	Stream	Iñupiaq	Line
5	Angutikada Peak	Aŋutiġruaq	Big man	Summit	Iñupiaq	Point
6	Angutikada Peak and adjacent hills	Aŋutigruaq	old man	Range	Iñupiaq	Point
7	Anirak Lake	Aniraq		Lake	Iñupiaq	Point
8	Asiksat Creek	Tulugaq		Stream	Iñupiaq	Line
9	Atla Creek	Donok'ededeleh No'	where fish swim in	Stream	Koyukon	Line
10	Atla Creek	Donok'ededeleh No'	where fish swim in	Stream	Koyukon	Point
11	Avaraat Lake	Avaaġaraat	Something yells	Lake	Iñupiaq	Line
12	Avaraat Lake	Avaaġaraat	Something yells	Lake	Iñupiaq	Point
13	Babantaltlin Creek			Stream	Koyukon	Line
14	Babantaltlin Creek			Stream	Koyukon	Point
15	Bandana Creek	Henots'oodelkkot No'	patch of birch river	Stream	Koyukon	Line
16	Bandana Creek	Henots'oodelkkot No'	patch of birch stream	Stream	Koyukon	Point
17	Bandana Creek mouth	Henots'oodelkkot Kkaakk'et	patch of birch mouth	Mouth	Koyukon	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
18	Batza River, Betze Creek	"Siskatonten"	looks good for bear upstream	Stream	Koyukon	Line
19	Batztoa Lake, 'Huggins Island', 'Florence Bar'	Baats'e T'oh	beneath obsidian	Lake	Koyukon	Line
20	Batztoa Lake, 'Huggins Island', 'Florence Bar'	Baats'e T'oh	beneath obsidian	Lake	Koyukon	Point
21	Beaver Creek	KY: Noye'e [No'], IN: Aqusriiġvik	KY, IN: beaver creek	Stream	Koyukon, Iñupiaq	Line
22	Bettles, Jane Creek	Kk'odlel T'odegheelenh Denh	place where current (creek) flows from the edged stone mountain	Stream	Koyukon	Line
23	Big Salt River	Tlaa Ts'oonesh No'	we obtain rocks creek	Stream	Koyukon	Line
24	Big Salt River	Tlaa Ts'oonesh No'	we obtain rocks stream	Stream	Koyukon	Point
25	Big Salt River site	Tlaa Ts'oonesh Denh	where we obtain rock	Locale	Koyukon	Point
26	Camp Creek	Kiiksugaq		Stream	Iñupiaq	Line
27	Camp Creek	Kiiksugaq		Stream	Iñupiaq	Point
28	Chetaut, site on north, 1 mile below Ray River	Tseet'ot	beneath Tsee	Village	Koyukon	Point
29	Cosmos Creek	Qalugrualigauraq		Stream	Iñupiaq	Line
30	Dagislakhna River	K'ehʉtleets'enh Taak'ezelaayh No'	downland side we put things in water stream	Stream	Koyukon	Line
31	Dahl Creek	Uqquqdioiq		Stream	Iñupiaq	Line
32	East Fork Tozee River	Neets'e Naaghedelenh No'	stream that flows from the upstream	Stream	Koyukon	Line
33	Ferguson Peak	Umiaviuraq	Little umiak place	Locale	Iñupiaq	Point
34	Fleshnana Creek	[Notl Denaadletl'oge No']	possibly ? It is concave stream	Stream	Koyukon	Line
35	Fleshnana Creek	[Notl Denaadletl'oge No']	possibly ? it is concave stream	Stream	Koyukon	Point
36	Gishna Creek	Łoyh Nebaa No'	grey sand creek	Stream	Koyukon	Line
37	Gishna Creek	Łoyh Nebaa No'	grey sand stream	Stream	Koyukon	Point
38	Harriet Creek	Todotekk'eyee No'	the one between the waters stream	Stream	Koyukon	Line
39	Harriet Creek	Todotekk'eyee No'	the one between the waters stream	Stream	Koyukon	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
40	Hatdolitna Hills	Hʉtodleetne Dlele'	? stream mountain	Range	Koyukon	Point
41	Helpmejack Lakes	Hulteeyee	It's a hook	Lake	Koyukon	Line
42	Henshaw Creek	Saagedle No'	possibly jaw hook river	Stream	Koyukon	Line
43	hill 1385	Deneyh T'on' Teye'	bearberry leaf hill	Summit	Koyukon	Point
44	Hog River, Hogatza River	Hʉgaadzaat No'	area-Ω-Ω stream	Stream	Koyukon	Line
45	Hughes Creek	Hʉt'odleetno'	flows beneath (mountains) stream	Stream	Koyukon	Line
46	Hughes Creek	Hʉt'odleetno'	flows beneath (mountains) stream	Stream	Koyukon	Point
47	Indian River	Baadzaatno'	obsidian creek, JJ: amethyst or agate stream	Stream	Koyukon	Line
48	Inerevuk Mountain	IN: Iñġivak, KY: Beneedze Ghelenee	IN: big mountain, KY: the one the current flows against	Summit	Iñupiaq, Koyukon	Point
49	Iniakuk Lake	Iñukuq	the name denotes something about a person	Lake	Iñupiaq	Line
50	Iniakuk Lake	Iñukuq	the name denotes something about a person	Lake	Iñupiaq	Point
51	Iniakuk River			Stream	Iñupiaq	Line
52	Iniakuk River			Stream	Iñupiaq	Point
53	Iñukuq	Iniakuk Lake	the name denotes something about a person	Lake	Iñupiaq	Line
54	Jack White Range	Todotekk'eyee	the one (mountain range) between the waters	Range	Koyukon	Point
55	Jim River	Noon Kuhno'	big animal (bear) stream, big porcupine stream	Stream	Koyukon	Line
56	John River	Eł Tseeyh No'	ochre-colored spruce boughs wind river	Stream	Koyukon	Line
57	Kichatakaka Creek & Alatna Portage	"Qitchaĝiiqaquutna"	? stream	Stream	Koyukon	Line
58	Kichatakaka Creek & Alatna Portage	"Qitchaĝiiqaquutna"	? stream	Stream	Koyukon	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
59	'king salmon downstream'	Gaał Doh	preceding king salmon	Locale	Koyukon	Point
60	Klalbaimunket Lake	Tleghelbaay Benkk'et	grayling lake	Lake	Koyukon	Line
61	Klalbaimunket Lake	Tleghelbaay Benkket	grayling lake	Lake	Koyukon	Point
62	Kobuk	Laugviik		Village	Iñupiaq	Point
63	Kobuk Creek	K'ehenuhts'en Tlaa Kuh No'	upland side big rock creek	Stream	Koyukon	Line
64	Kobuk Creek	K'ehenuhts'en Tlaa Kuh No'	upland side big rock stream	Stream	Koyukon	Point
65	Kobuk River from the lower canyon to its source	Quġlut	Waterfall	Stream	Iñupiaq	Line
66	Kobuk River from the lower canyon to its source	Quġlut	Waterfall	Stream	Iñupiaq	Point
67	Kobuk River; Selawik River (JJ)	KY: Hʉlghaatno', IN: Kuuvak	KY: river in the oily area, IN: big river	Stream	Koyukon, Iñupiaq	Line
68	Kogoluktuk River	Quġluqtuq	it has waterfalls	Stream	Iñupiaq	Line
69	Kogoluktuk River	Quġluqtuq	it has waterfalls	Stream	Iñupiaq	Point
70	Kollioksak Lake	Qalluiqsat		Lake	Iñupiaq	Line
71	Kollioksak Lake	Qalluiqsat		Lake	Iñupiaq	Point
72	Koskatantna Creek			Stream	Koyukon	Line
73	Koskatantna Creek			Stream	Koyukon	Point
74	Koyukuk River	Ooghe Kuh No'	big stream off in the distance; loan	Stream	Koyukon	Line
75	Kuikcherk River	Kuutchauraq		Stream	Iñupiaq	Line
76	Kuikcherk River	Kuutchauraq	Big creek	Stream	Iñupiaq	Point
77	Lake Anirak	Aniraq		Lake	Iñupiaq	Line
78	Lake Minakokosa	Menkk'e Hʉse	great lake	Lake	Koyukon	Line
79	Lake Minakokosa	KY: Menkk'e Hʉse, IN: Miniqaqusa	great lake	Lake	Koyukon, Iñupiaq	Point
80	Lakes on trail to the middle of Ambler River	Tiŋmiaqsiuġiat	Look for geese	Lake	Iñupiaq	Point
81	Little Hog River area	Hʉgaadzaat No' Hʉse	area-Ω-Ω stream large	Locale	Koyukon	Point
82	Little Indian River	"Khodo Batzitna"		Stream	Koyukon	Line
83	Long Bend	Tledokedeenaał Denh	long stream peninsula, also called Twelve Mile Camp	Site	Koyukon	Point
84	Lower Kobuk Canyon	Nauyyaat	Young seagulls	Landform	Iñupiaq	Point
85	Mastodon Bank EJQ	IN: Akuliġaq, KY: To'eeleeyh Denh	IN: Rivers meet, KY: strong currents flow	Locale	Iñupiaq, Koyukon	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
86	Mauneluk River	Maniilam kuuŋa	rough place river	Stream	Iñupiaq	Line
87	Middle Fork of the Koyukuk River	Tlaakk'oł Neekk'e	whetstone mountain	Stream	Koyukon	Line
88	Middle Fork of the Koyukuk River	Tlaakk'oł Neekk'e	whetstone mountain	Stream	Koyukon	Point
89	middle Yukon River	DH: Yeqin, HO: Yooqin, KY: Yookkene, GW: Yuukon, HN: Chuu K'onn, UK: Yukwna, LT: Yukwn, MT: Yuukun Na', TC: Tuu Kon', UT: Yikaax Tu'	KY, GW: Ω, DH, UK: ?ambiguous, HO: upland+? ambig., LT: (not certain) to prompt a shaman, MT, TC: clear water, HN: fire/spark? water, UT: Ω water	Stream	Deg Hit'an, Holikachuk, Koyukon, Gwich'in, Han, Upper Kuskokwim, Lower Tanana, Middle Tanana, Tanacross, Upper Tanana	Line
90	Moose Creek, Campbell Cr (JJ)	Taaghe Tleekk'e No'	underwater downland side stream	Stream	Koyukon	Line
91	mountain 4230	Maniilaq	rough place	Summit	Iñupiaq	Point
92	mountain at head of Hogatza River	Hʉgaadzaat No' Dlele'	area-Ω-Ω stream	Summit	Koyukon	Point
93	mouth of Hughes Creek, Hughes (village)	Hʉt'odlee Kkaakk'et	flows beneath (mountains) mouth	Mouth	Koyukon	Point
94	Naniratkohort Creek			Stream	Iñupiaq	Line
95	Naniratkohort Creek			Stream	Iñupiaq	Point
96	Narvak Lake	Narvak	two lakes	Lake	Iñupiaq	Line
97	Ninemile Hills	Ełtseeyh Kkaakke Le'one	that which sits at the mouth of wind lodge stream	Summit	Koyukon	Point
98	Norutak Lake	Nauyatuuq	it has young seagulls	Lake	Iñupiaq	Line
99	Norutak Lake	Nauyatuuq	it has young seagulls	Lake	Iñupiaq	Point
100	Notoniono Creek	Notonee'ono'	water that extends across (country) stream	Stream	Koyukon	Line
101	Nullauket Pass Lake ?	Taak'ezelaayh Mene'	we put things in water lake	Lake	Koyukon	Line
102	Nutuvukti Lake	KY: "Nautauraqti" [Notoghoteeł Denh], IN: Nautauraqti	KY: possibly swirling water place, IN: Indian [Koyukon?] word	Lake	Koyukon, Iñupiaq	Line
103	Nutuvukti Lake	IN, KY: "Nautauraqti" [Notoghoteeł Denh]	possibly swirling water place	Lake	Iñupiaq, Koyukon	Point
104	On the way north	Sivutmugiaq	Going on a straight course	Locale	Iñupiaq	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
105	Pick River	Sikłaksram kuuŋa	material for an adze, pick axe	Stream	Iñupiaq	Line
106	Pick River	Sikłaksram kuuŋa	material for an adze, pick axe	Stream	Iñupiaq	Point
107	Ravens Creek	Tulugaq	Raven	Stream	Iñupiaq	Point
108	Ray River	GW: [K'iitł'it Gwich'in Njik], KY: Tseet'otno'	GW: beneath Tsee stream; birch headwaters, KY: beneath Tsee stream	Stream	Gwich'in, Koyukon	Line
109	Ray River	GW: [K'iitł'it Gwich'in Njik], KY: Tseet'otno'	GW: beneath Tsee stream; birch headwaters, KY: beneath Tsee stream	Stream	Gwich'in, Koyukon	Point
110	Ray River mouth	Tseet'otno' Chaaget	beneath Tsee stream	Mouth	Koyukon	Point
111	Reed River	Aŋiliġaġiaq	way to go home	Stream	Iñupiaq	Line
112	Selby River	Anauliġvik		Stream	Iñupiaq	Line
113	Selby River	Anauliġvik	Place to beat something	Stream	Iñupiaq	Point
114	Shungnak River	Isiŋnam kuurua	jade creek	Stream	Iñupiaq	Line
115	Sightas Island	Tseet'o Noo'u	beneath Tsee island	Island	Koyukon	Point
116	Siruk Creek	Alatna Hʉketsaalaatne	Ω stream beaver harvest stream (likely Inupiaq-origin name)	Stream	Koyukon	Line
117	Site near a portage to Kobuk River from Hogatza River	Agiatchianaq		Site	Iñupiaq	Point
118	Slathtouka Creek	Ts'ookk'ełno'	mountain stream, entranceway to sod house or underground house, tunnel	Stream	Koyukon	Line
119	Slokhenjikh Creek	Łoyh Netseyh No'	gravel nose stream	Stream	Koyukon	Line
120	stream below McQuesten Creek	Deneyh T'on' No'	bearberry leaf creek	Stream	Koyukon	Line
121	stream below McQuesten Creek	Deneyh T'on' No'	bearberry leaf stream	Stream	Koyukon	Point
122	The end of a ridge near the trail to the upper Ambler River	Urgiiḷiqsuuq	Birch hill	Locale	Iñupiaq	Point
123	The mouth of a slough	Isruqtauraq	Muddy water	Mouth	Iñupiaq	Point
124	The old mouth of Qugluqtuq	Quġluqtum Paaġruaq		Mouth	Iñupiaq	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
125	Timber Creek	Sehne Hʉyoze	small sidestream	Stream	Koyukon	Line
126	Timber Creek	Sehne Hʉyoze	small sidestream	Stream	Koyukon	Point
127	Totzitigi Portage	IN: Itivliq, KY: Tots'eeteyet	IN: Portage place , KY: canoe water place	Trail	Iñupiaq, Koyukon	Point
128	Tunalkten Hot Spring	Too Naaleł Denh	hot springs or place where the water is hot	Stream	Koyukon	Point
129	Twilight Creek, uppermost Tozitna fork	Tlaa Ghu Tleets'eneełtonh Denh	where we have trail by the rocks, game trail extends by the rocks	Stream	Koyukon	Line
130	Twilight Creek, uppermost Tozitna fork	Tlaa Ghu Tleets'eneełtonh Denh	where we have trail by the rocks, game trail extends by the rocks	Stream	Koyukon	Point
131	Upper Kobuk Canyon	Quġlut	Big waterfall	Landform	Iñupiaq	Point
132	upper Melozitna R above Little Melozitna confluence	K'eloghozeetno'	etymology doubtful ? stream	Stream	Koyukon	Line
133	upper Pah River	Ts'eeteetne	canoe trail river	Stream	Koyukon	Line
134	upper Pah River	Siitina	(An Indian name)	Stream	Iñupiaq	Line
135	upper Shungnak River	Qalugrualik		Stream	Iñupiaq	Line
136	Walker Lake	KY: Taah K'ehoolaanh, IN: Qalugluktuaq	KY: where there are lots of things in the water, IN: big fish	Lake	Koyukon, Iñupiaq	Line
137	Wesley Creek	Qiaqsuq		Stream	Iñupiaq	Line
138	Wild River	Dodzen Beetno'	common loon canyon river	Stream	Koyukon	Line
139	Wild River	Dodzen Beetno'	common loon canyon stream	Stream	Koyukon	Point
140	Woodcamp Ck OR Fort Hamlin Hills Ck	Łel'one No'	creek of the one on the perimeter	Stream	Koyukon	Line
141	Woodcamp Ck OR Fort Hamlin Hills Ck	Łel'one No'	stream of the one on the perimeter	Stream	Koyukon	Point
142	Wrongtrail Creek	Ggʉh No'	rabbit river	Stream	Koyukon	Line
143	Zane Hills	Siklaksraq Asiksit	material for an adze, pick axe	Range	Iñupiaq	Point
144		Ts'ebaa Negge	behind the timber or timber all the way from the mountain to the stream	Stream	Koyukon	Line

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
145		Saavaayiqsuruaq	"A kind of small fish." A channel of Kobuk River.	Stream	Iñupiaq	Line
146		Kanayium Narvaat		Lake	Iñupiaq	Line
147		Aqpatchuilaq		Lake	Iñupiaq	Line
148		Itchubvik		Lake	Iñupiaq	Line
149		Kiirim Narvaa		Lake	Iñupiaq	Line
150		Kuugaatchiavak		Stream	Iñupiaq	Line
151		Uumman		Stream	Iñupiaq	Line
152		Avgun		Stream	Iñupiaq	Line
153		Savigiksabvik		Stream	Iñupiaq	Line
154		Unaqsibiaq		Stream	Iñupiaq	Line
155		Atannibiutchiak		Stream	Iñupiaq	Line
156		Tuqaatqan		Stream	Iñupiaq	Line
157		Kuutchiabruaq		Stream	Iñupiaq	Line
158		Isruqtauraq		Stream	Iñupiaq	Line
159		Saiyuuq		Stream	Iñupiaq	Line
160		Umiaviuraq		Stream	Iñupiaq	Line
161		Avallaq		Stream	Iñupiaq	Line
162		Napuuraq		Stream	Iñupiaq	Line
163		Tiwmiaqsiubiat		Lake	Iñupiaq	Line
164		Unaqsibiaq		Stream	Iñupiaq	Line
165		Savigiksabvik		Stream	Iñupiaq	Line
166		Avgun		Stream	Iñupiaq	Line
167		Avgun		Stream	Iñupiaq	Line
168		Iqsrabutiliqabliq		Lake	Iñupiaq	Line
169		Subliat		Lake	Iñupiaq	Line
170		Taqqio		Lake	Iñupiaq	Line
171		Nausrubniqturuaq		Stream	Iñupiaq	Line
172		Aqpatchuieaq		Stream	Iñupiaq	Line
173		Kawiwiuqsivik		Stream	Iñupiaq	Line
174		Niliq		Stream	Iñupiaq	Line
175		Qaalbiqsuuq		Stream	Iñupiaq	Line
176		Qaliam Kuubua		Stream	Iñupiaq	Line
177		Saiyuubiaq		Stream	Iñupiaq	Line
178		Sivulliqsruqti		Stream	Iñupiaq	Line
179		Kaazen Nozegheełkkonh Denh	place someone burned down (a tree with a) lynx	Locale	Koyukon	Point
180		Neenots'eeyhleyaayh Denh	place where canoes are left	Locale	Koyukon	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
181		Ntl'et Noo'	lowbush cranberry island	Island	Koyukon	Point
182		Tlaamaas ghʉnh	by semi-circular knife	Locale	Koyukon	Point
183		[Neeɫts'aahʉdaadonh]	where ravines separate	Locale	Koyukon	Point
184		Deekk'aatl'one	cut bank	Landform	Koyukon	Point
185		Tseet'o Dlele'	beneath Tsee mountain	Summit	Koyukon	Point
186		Tlaa Nedeggaadle Ghʉnh	at the roots on the rock, at the rocks standing like tree roots	Summit	Koyukon	Point
187		Tauiiliik		Locale	Koyukon	Point
188		Quġluqtuq	big falls	Village	Iñupiaq	Point
189		Itchuġvik	Goose blind place	Lake	Iñupiaq	Point
190		Kuugaatchiavak	Big creek	Stream	Iñupiaq	Point
191		Qayaitchuq	It has no kayaks	Locale	Iñupiaq	Point
192		Kiirim Narvaa	Gray jay lake	Lake	Iñupiaq	Point
193		Saiyuuq	Water like tea	Stream	Iñupiaq	Point
194		Umittaq		Locale	Iñupiaq	Point
195		Suġliat	Young grebes	Locale	Iñupiaq	Point
196		Kaŋiġaaġruk	Caribou corral	Locale	Iñupiaq	Point
197		Qiiġaaq		Locale	Iñupiaq	Point
198		Aŋatkuq	Shaman	Island	Iñupiaq	Point
199		Saiyuuġiaq		Locale	Iñupiaq	Point
200		Quġluqtum Paaŋa	Mouth of	Mouth	Iñupiaq	Point
201		Kanayium Narvaat	Sculpin Lake	Lake	Iñupiaq	Point
202		Napaaqtuġvik	Timber place	Locale	Iñupiaq	Point
203		Ayauppivik	Net pole making place	Locale	Iñupiaq	Point
204		Savium Kivvivia	Place where knife sank	Locale	Iñupiaq	Point
205		Nuvugluktuaq	Broken-top tree	Locale	Iñupiaq	Point
206		Itqiḷiqɫuk	Old Indian	Locale	Iñupiaq	Point
207		Aqpatchuiḷaq	Not running	Locale	Iñupiaq	Point
208		Iḷuvaurat	Little graveyard	Cemetery	Iñupiaq	Point
209		Nausruġniqturuaq	Lots of snags	Locale	Iñupiaq	Point
210		Ipliġvik	Somebody fell down	Site	Iñupiaq	Point
211		Aqpatchuiḷaq	Not running	Lake	Iñupiaq	Point
212		Salliñauraq	Little seining place	Island	Iñupiaq	Point

Place Name #	USGS Name	Name	Translation	Type	Origin	Feature type
213		Patiqturuqsiuqtuaq	Bone marrow gets too cold or too painful (from icy water)	Locale	Iñupiaq	Point
214		Iqsratchiaq		Cemetery	Iñupiaq	Point
215		Naattaat	Young great gray owls	Locale	Iñupiaq	Point
216		Sivulliqsruqti	One who goes ahead or leads	Stream	Iñupiaq	Point
217		Iyaġak	Rock hill	Summit	Iñupiaq	Point
218		Avuġaluk		Locale	Iñupiaq	Point
219		Quġluqtuq	Waterfall	Locale	Iñupiaq	Point
220		Tulukkaaqsiuġayuk	Obtain young ravens	Locale	Iñupiaq	Point
221		Uqquqłiñiq	Below big creek	Locale	Iñupiaq	Point
222		Qaiqsuq	Flat place	Locale	Iñupiaq	Point
223		Savigiksaġvik	Place to fix a broxen knife	Stream	Iñupiaq	Point
224		Avgun	Dividing line	Stream	Iñupiaq	Point
225		Unaqsiġiaq	Look for good wood	Stream	Iñupiaq	Point
226		Savigiksaġvik	To fix a broken knife	Stream	Iñupiaq	Point
227		Tuqaatqan		Stream	Iñupiaq	Point
228		Kaŋiŋiiqsivik	A narrow canyon through which caribou were driven for killing	Locale	Iñupiaq	Point
229		Qaama	A place named after a person	Locale	Iñupiaq	Point
230		Igluġautchiaq	A place named after a person	Locale	Iñupiaq	Point
231		Akitchiaq	A place named after a person	Locale	Iñupiaq	Point
232		Aktuq	A place named after a person	Locale	Iñupiaq	Point
233		Sautnaq	A place named after a person	Locale	Iñupiaq	Point
234		Ayuġaitchiaq	A place named after a person	Locale	Iñupiaq	Point
235		Aŋiḷġaġiaq	Going way home; a trapping area	Locale	Iñupiaq	Point

Source: Smith and Kari 2023

1.8.2 Environmental Consequences

Table 35 and Table 36 list the number of AHRS sites within the cultural resource study area as well as the project route corridors.

Table 35. Total number of AHRS sites within the 10-mile project route study area*

Alternative	Mileage	Number of AHRS Sites	Determined Eligible	Determined Not Eligible	Unevaluated
Alt A - AIDEA Proposed	211.18	305	3	10	292
Alt B - AIDEA Alternative	228.37	148	2	10	136
Alt C – Diagonal Route	317.43	62	4	6	52

Source: ADNR, Office of History and Archaeology 2023

Table 36. AHRS sites within the project route corridors*

Corridor	Mileage	Number of AHRS Sites	Determined Eligible	Determined Not Eligible	Unevaluated
Alt A - AIDEA Proposed	211.18	12	None	1	11
Alt B - AIDEA Alternative	228.37	7	None	1	6
Alt C – Diagonal Route	317.43	5	1	3	1

Source: ADNR, Office of History and Archaeology 2023

Table 37 lists the Revised Statute 2477 (RS2477) trails found in the cultural resources study area, as well as corridors within the direct and indirect effects areas. Volume 4, Maps 3-26 and 3-29 depict the locations of the RS2477 rotes.

Table 37. RS2477 trails in the cultural resources study area and corridor*

RST number	RST name	RS2477 trail within corridor	RS2477 trail within study area
RST 105	Alatna-Shungnak	Alternative C	Alternative B, Alternative C
RST 1611	Bergman-Cathedral Mountain	Alternative A, Alternative B	Alternative A, Alternative B
RST 1718	Kobuk-Dahl Creek Trail	N/A	Alternative A, Alternative B, Alternative C
RST 1719	Wesley Creek Trail	Alternative C	Alternative A, Alternative B, Alternative C
RST 1720	Dahl Creek-Wesley Creek Trail	Alternative C	Alternative C
RST 1741	California Creek Trail	N/A	Alternative A, Alternative B, Alternative C
RST 1742	Kobuk River-California Creek Mine	N/A	Alternative A, Alternative B
RST 1744	Kobuk River-Junction	Alternative C	Alternative C
RST 1745	Kobuk-Dahl Creek Landing Field	N/A	Alternative C
RST 18	Bettles-Wild Lake River Trail	Alternative A, Alternative B	Alternative A, Alternative B
RST 1913	Pah River Portage	Alternative C	Alternative C
RST 209	Bettles-Coldfoot	Alternative A, Alternative B	Alternative A, Alternative B
RST 289	Tanana-Allakaket	Alternative C	Alternative C
RST 308	Hughes-Mile 70	Alternative C	Alternative C
RST 38	Tramway Bar	Alternative A, Alternative B	Alternative A, Alternative B
RST 412	Slate Creek	Alternative A, Alternative B	Alternative A, Alternative B

RST number	RST name	RS2477 trail within corridor	RS2477 trail within study area
RST 450	Hickel Highway	Alternative A, Alternative B	Alternative A, Alternative B

Source: ADNR, Division of Mining, Land, and Water n.d.

Note: RST = Revised Statute Trail.

Table 38 and Table 39 list the number of place names within the cultural resource study area as well as the project route corridors.

Table 38. Place names within the project route corridors*

Corridor	Mileage	Number of place name points	Number of place name lines
Alt A - AIDEA Proposed	211.18	0	16
Alt B - AIDEA Alternative	228.37	0	18
Alt C – Diagonal Route	317.43	1	26

Source: Smith and Kari 2023

Table 39. Place names within the project study area*

Corridor	Mileage	Number of place name points	Number of place name lines
Alt A - AIDEA Proposed	211.18	35	45
Alt B - AIDEA Alternative	228.37	35	47
Alt C – Diagonal Route	317.43	94	69

Source: Smith and Kari 2023

Table 40 through Table 42 summarize the results of cultural resources sensitivity modelling for each alternative. For purposes of the model, "study area" was defined as a 20-mile buffer centered on the 3 alternative routes (Sweeney and Simmons 2019).

Table 40 summarizes the results of cultural resources sensitivity modelling for Alternative A. There are a total of 2,695,857.8 model study acres for Alternative A.

Table 40. Model results, Alternative A

Model value	Model value acreage for study area (acres)	Percentage (%)
High	978,408.3	36.3
Medium	1,306,638.2	48.5
Low	410,811.3	15.2
Total	2,695,857.8	100.0

Source: Adapted from Sweeney and Simmons 2019

Table 41 summarizes the model results for Alternative B. There are a total of 2,870,235.7 total study acres for Alternative B.

Table 41. Model results, Alternative B

Model value	Model value acreage for study area (acres)	Percentage (%)
High	1,114,208.0	38.8
Medium	1,361,150.5	47.4
Low	394,877.1	13.8
Total	2,870,235.7	100.0

Source: Adapted from Sweeney and Simmons 2019

Table 42 summarizes the model results for Alternative C. There are a total of 4,971,935.4 total study acres for Alternative C.

Table 42. Model results, Alternative C

Model value	Model value acreage for study area (acres)	Percentage (%)
High	2,022,278.0	40.7
Medium	1,895,499.5	38.1
Low	962,693.0	19.4
No Value	91,464.9	1.8
Total	4,971,935.4	100.00

Source: Adapted from Sweeney and Simmons 2019

2. References*

ADCCED (Alaska Department of Commerce, Community and Economic Development), Division of Community and Regional Affairs. 2019. Community Database Online. Available at: dcra-cdo-dcced.opendata.arcgis.com/. Accessed February 23, 2019.

ADF&G (Alaska Department of Fish & Game). 2019. Community Subsistence Information System: Csis. Harvest by Community. Available at: www.adfg.alaska.gov/sb/CSIS/index.cfm?ADFG=harvInfo.harvestCommSelComm. Accessed May 2018.

ADNR (Alaska Department of Natural Resources), Division of Mining, Land, and Water. n.d. RS2477 Project. Available at: www.dnr.state.ak.us/mlw/trails/rs2477/index.cfm.

ADNR, Office of History and Archaeology. 2023. Alaska Heritage Resources Survey Online Database. Available at: dnr.alaska.gov/parks/oha/ahrs/ahrs.htm.

ADOLWD (Alaska Department of Labor and Workforce Development). 2019. Northwest Arctic Borough and Yukon-Koyukon Census Area Annual Average Resident Employment by Industry, 2014–2016.

Alaska Energy Data Gateway. 2019. Community Metric Explorer. Available at: akenergygateway.alaska.edu/. Accessed February 18, 2019.

Alaska.org. n.d. Alaska Float Trips. www.alaska.org/float-trips. Accessed March 2019.

American Packrafting Association. n.d. Forums. Available at: packrafting.org. Accessed March, 2019.

Blanchard, M.R., R.O. Stern, J. Rogers, D. Guilfoyle, P.M. Bowers, R. Gordaoff, H. Brown, G. Neufeld, and M. Phillips. 2014. Cultural Resources Overview and Data Gap Analysis, Ambler Mining District Industrial Access Road Project (AMDIAR). Prepared by Northern Land Use Research Alaska, LLC for DOWL HKM. Anchorage, Alaska.

BLM (Bureau of Land Management). 1991. *Utility Corridor Resource Management Plan/Environmental Impact Statement Record of Decision*. Available at: eplanning.blm.gov/epl-front-office/projects/lup/35315/43921/47272/UtilityRMP_ROD_web.pdf.

BLM. 2012. *National Petroleum Reserve-Alaska Final Integrated Activity Plan /Environmental Impact Statement*. U.S. Department of the Interior, Bureau of Land Management. Anchorage, Alaska.

Giddings, J.L., and D. Anderson. 1986. *Beach Ridge Archaeology of Cape Krusenstern: Eskimo and Pre-Eskimo Settlements Around Kotzebue Sound, Alaska*. Publications in Archeology No. 20. U.S. Department of the Interior, National Park Service. Washington, D.C.

National Conference of State Legislatures. 2018. Federal and State Recognized Tribes. Available at: www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx. Accessed February 28, 2019.

Sweeney, M.A., and L.J. Simmons. 2019. Cultural Resources Sensitivity Model for the Ambler Mining District Industrial Access Project. Prepared for DOWL and Alaska Industrial Development and Export Authority. May 2019.

U.S. Census Bureau. 2023. American FactFinder: American Community Survey. Available at: https://data.census.gov/. Accessed June 21, 2023.

USFWS (U.S. Fish and Wildlife Service). n.d. Plan Your Visit. Selawik National Wildlife Refuge – Alaska. Available at: www.fws.gov/refuge/Selawik/visit/plan_your_visit.html. Accessed March 2019.

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